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End-of-waste criteria for waste paper:

Technical proposals

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Final report

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1. Introduction

1.1. Background

The recently passed Waste Framework Directive (2008/98/EC, in the following referred to as 'the Directive' or WFD) among other amendments introduces a new procedure for defining end-of-waste (EoW) criteria, which are criteria that a given waste stream has to fulfil in order to cease to be waste.

Waste streams that are candidates for this procedure must have undergone a recovery operation, and comply with a set of specific criteria. The actual shape of such criteria is to be defined specifically for each waste stream, but the general conditions that a waste material has to follow are defined by Article 6 of the WFD in the following terms:

'certain specified waste shall cease to be waste [within the meaning of point (1) of Article 3] when it has undergone a recovery, including recycling, operation and complies with specific criteria to be developed in accordance with the following conditions:

a) The substance or object is commonly used for a specific purpose;
b) A market or demand exists for such a substance or object;
c) The substance or object fulfils the technical requirements for the specific purpose referred to in (a) and meets the existing legislation and standards applicable to products; and
d) The use of the substance or object will not lead to overall adverse environmental or human health impacts.'

Moreover, Articles 6(2) and 39(2) of the Directive specify the political process of decision-making for the criteria on each end-of-waste stream, in this case a Comitology procedure[1] with Council and Parliament scrutiny. As input to this decision-making process in Comitology, the European Commission is to prepare proposals for end-of-waste criteria for a number of specific waste streams, including waste paper[2]. The expected outputs of this process would be Commission Regulations on end-of-waste for the concerned streams.

A methodology guideline[3] to develop end-of-waste criteria has been elaborated by the Joint Research Centre's Institute for Prospective Technological Studies (JRC-IPTS) as part of the so-called 'End-of-Waste Criteria' report. The European Commission is currently working on preparing proposals for end-of-waste criteria for specific waste streams according to the legal conditions and following the JRC methodology guidelines.

As part of this work, and for each candidate waste stream, the IPTS prepares separate studies with technical information that will support each of the proposals for end-of-waste criteria. Besides describing the criteria, these studies will include all the background information necessary for ensuring conformity with the conditions of Article 6 of the Directive.

For each waste stream, the technical studies are developed based on the contributions from stakeholders, by means of a Technical Working Group. The Technical Working Group on waste paper has been composed of experts from Member States administration, industry, NGOs and academia. The experts of the group have contributed with data, information or comments to draft versions of this report, and through participation in two expert workshops organised by the IPTS and held 9 November 2009 and 23 March 2010. Using as guidance the developed methodology and the input from the experts of the Technical Working Group, the IPTS has prepared this final report.

[1] The progress of the Comitology processes on the WFD can be followed at: http://ec.europa.eu/transparency/regcomitology/index_en.htm
[2] Paper and cardboard are analysed together, as they are essentially composed of the same material (cellulose fibres) and their life cycles often become part of each other, either deliberately as feedstock or as an inflow of impurities
[3] End-of-waste documents from the JRC-IPTS are available from http://susproc.jrc.ec.europa.eu/activities/waste/. See in particular the operational procedure guidelines of Figure 5 in the "End-of-Waste Criteria" report.

The IPTS authors of this report would like to acknowledge the valuable contributions from the experts of the Technical Working Group.

1.2. Objectives

This technical report presents proposals of end-of-waste (EoW) criteria for waste paper, and it defines the technical requirements that waste paper has to fulfil in order to cease to be waste in the EU, in conformity with Article 6 of the WFD. The report includes the background data and assessments used to support the proposals, including a comprehensive techno-economic analysis of waste paper recycling, and analyses of the potential economic, environmental and legal impacts when waste paper ceases to be waste.

1.3. Scope definition

Terminology note

In this report, the term *waste paper* refers to paper and cardboard from industrial or household origin which is collected, sorted, and in general reclaimed and processed for recycling. The most common term in use in the industry to define waste paper is *recovered paper*. The term *recovery* exists in EU law with a different, wider meaning, therefore the term *recovered paper* has not been used in this document to avoid misinterpretations with existing definitions in EU law, except for quotations of existing titles using the term such as association names, or grading standard names.

This terminology choice is made for the only purposes of ensuring coherence among EU texts and avoiding any future misinterpretation, and does not bear any implicit judgment about the value of the paper material. When reading *waste paper,* one should understand what is known in industry as *recovered paper.* Some stakeholders have suggested the use in the legal text to be prepared of the term *paper for recycling* to refer to waste paper collected for the purpose of production of new paper. By the addition of appropriate definitions and complementary recitals, the legal text could also make use of the term *recovered paper.*

Potential for energy recovery of waste paper - restriction of scope to recycling

The scope of the proposal of End-of-waste criteria for waste paper presented in this document is only to waste paper processed for paper fibre recycling, e.g. for use in papermills. The use of paper that has ceased to be waste in non-recycling recovery operations, i.e. energy or backfilling purposes, and non-papermill recycling uses (e.g. composting, filling material, animal bedding) are not part of the scope of the End-of-waste criteria here presented.

It is important to note that this restriction of scope is designed as to not alter the practice, technology development or the markets of other uses different from recycling into paper. Such alternative uses may continue their course under waste law. This means also that end-of-waste material can be sold for these non-papermaking uses, but in doing so, the material will return to its waste status and no longer be a product.

A detailed explanation of the rationale for this limitation of scope is provided in the following.

Firstly, fibre recycling is the only current common specific purpose that has been identified in the EU for waste paper as a separate material flow, i.e. not as part of a mixture in refuse-derived fuel or municipal solid waste. As explained below, there is currently no evidence that non-papermill recycling or energy uses of waste paper are commonly used specific purposes for waste paper, except for very specific waste paper

grades (see details below) that represent very small percentages (under 8% of the collected paper flow[4]), and are in most cases part of multi-material mixtures.

Secondly, a market as such does not exist today for waste paper to incineration. The analysis below and in the Chapter on impacts indicates that a market for energy recovery of waste paper may exist in the future, but there is no evidence of it today. As for non-papermill recycling uses, the market for these are marginal, and they are to be considered as end-use alternatives to disposal. In these uses, waste paper quality is of little interest, and the use is driven by availability at very low or no cost of low-quality waste paper fractions, which are adequate for delivering single-use properties (water absorption, nutrients in wood fibres, soil structure improvement, insulation), but are actually a downgrading of the material, that render it unfit for further recycling.

In summary, two of the conditions of Art.6 of the WFD, namely (a) the existence of a commonly used specific purpose, and (b) the existence of a market, are only fulfilled by fibre recycling in paper manufacture.

In the EU, some waste paper fractions are for several reasons not appropriate for paper fibre recycling processes, either because of a high content of non-paper components or mix with other flows (e.g. waste plastics, waste food, metal scrap, waste glass), because of the fibre type (e.g. long cotton fibres of special papers such as waste money paper), or because of the reduced fibre size (e.g. waste paper from confidential document destruction that has a small size not suited for all mills). Fractions that do not find a way into paper mills have other possible outlets in the EU, most notably:

- Energy use in incineration plants (normally without intermediate treatment).
- Energy use in cement plants (sometimes with shredding or other size homogenisation treatment).
- Use as fill an insulation material, often with the addition of fire retardant chemicals, fungal resistance chemicals, vermin protection, and binding chemicals up to 20% of weight.
- Use for animal bedding (sometimes with shredding or other size homogenisation treatment).
- Composting (sometimes preceded by shredding).
- Gardening and landscaping (roadside restoration, plant pots).
- Disposal in landfills.

The energy use of waste paper in biomass plants could also be a theoretical option, but in the EU it has only been practised at pilot level, and requires a very homogeneous quality of the waste paper input flow.

The waste paper amounts currently incinerated in cement kilns in the EU are very limited compared with the total waste paper flows generated and reclaimed. Data from Cembureau as reported by EU cement companies estimate that in 2006 about 2000 TJ of paper (about 130 000 tonnes[5]) were used as energy source and clinker additive in cement plants in the EU27. In 2003 and 2004, these figures were respectively 215 000 and 302 000 tonnes[6]. These figures include all paper residues, including RDF, sludges, dry cakes and other fibre rejects from paper mills, and in total amount to less than 0.6% of the total reclaimed waste paper in the EU (>50 Mt since 2004). The energy recovery market for paper fibre flows to cement kilns is therefore very limited to date.

Waste paper not currently used for papermaking is paper that is not separate-collected, be it at source or in multi-material collection (e.g. comingled, packaging) systems. Its current outlet in the EU is either landfilling, recycling other than in papermills, or incineration, be it directly as MSW or after processing to RDF. The yearly amount non-recycled to paper in the EU is ca. 28.5 Mt (CEPI, 2009), most of it in mixed as MSW from households and commerce. Only between 1.5 and 2.5 Mt of waste paper are part of RDF and are currently incinerated (WRc, 2003)[7]. From the remaining amount of ca. 26 Mt, ca. 20% (5-6 Mt), is

[4] Data from CEPI, 2009

[5] Assuming an average energy content in paper of 15GJ/tonne. Assuming all was wet paper with an energy content of 10 GJ/tonne, the amount would be 200.000 tonnes in 2006.

[6] Cembureau, pers. comm. Inneke Claes, Cembureau, Brussels, February 2009

[7] Assuming a range of 30-80% paper fibres in RDF from MSW, and 2-3Mt annual production of RDF in the EU (WRc, 2003)

incinerated in MSW incinerators[8], and the rest (22-23 Mt) is non-collectable (6.3 Mt), landfilled (15Mt), or applied to non-papermill recycling purposes (0.4 Mt composting, 0.8Mt insulation and filling).

In addition to the non-fulfillment of the fist two conditions of Art.6, there are additional arguments that do not favour the inclusion of non-papermill recycling or energy recovery as part of the currently developed waste paper EoW criteria.

One of them is that the technical requirements, the legislation and the standards that would apply for waste paper destined to non-papermill recycling or energy would be both conceptually and in the details totally different from those that apply for paper fibre recycling uses, because fibre recycling is a mechanical processing of fibres into a new product that only paper fibres can meet, whereas incineration is a chemical reaction of substitution of other fuels. Non-papermill recycling purposes have the focus on totally different properties (water absorption, nutrient content in wood fibres, soil structure improvement, insulation) than papermaking (among others presence of ink, type and quality of fibre, presence and type of non-paper components). An example of this is that CEN standards for recovered paper have little in common with CEN technical specifications for solid recovered fuels. Different types of pollutants are of concern in each case, e.g. PVC and chlorine content limits are needed for incineration and are not for fibre recycling. The quality criteria, containing limit values and impurity thresholds, would be essentially different, and it would be a wrong approach to attempt to merge all limit values for the sole purpose of creating a set of EoW criteria encompassing all uses of waste paper.

Another argument supporting the limitation of scope presented is the avoidance of conflict with existing legislation promoting recycling, both at EU level and national or regional level. The packaging waste Directive (94/62/EC amended by 2004/12/EC and 2005/20/EC including extended deadlines for new Member States) sets targets for the recycling of a number of recyclable packaging materials, including paper. In case the criteria on EoW was not limited to recycling, part of waste paper packaging paper may be diverted as EoW to non-recycling uses, and this may create additional difficulties in the achievement of the recycling targets agreed by Member States under the packaging directive. Some Member States or regions have additional prescriptions under waste law to avoid the incineration of recyclable material e.g. Flanders, Denmark, and Netherlands. These prescriptions would not apply to material that is not any more waste. By limiting the scope of End-of-waste to fibre recycling, no loophole is created.

The remaining condition under Article 6 of the WFD is condition (d), which stipulates that End-of-waste shall not lead to overall adverse environmental or health impacts. The revised WFD defines in Article 4 a five-step waste hierarchy, stating that it shall apply as a priority order in waste prevention and management legislation and policy. Following the hierarchy, recyclable material should not be incinerated. However, Article 4 also specifies that Member States shall take measures to encourage the options that deliver the best overall environmental outcome, and this may require specific waste streams departing from the hierarchy where this is justified by life-cycle thinking on the overall impacts of the generation and management of such waste. In the instance of waste paper, several system analyses and life-cycle assessment reviews[9] have confirmed that in many cases waste paper recycling is preferable to incineration, but there are also cases of low quality waste paper, the recycling of which is based on fossil fuel energy, where incineration is an environmentally preferable option. As mentioned above, some Member States or regions have chosen to implement these prescriptions as bans on the incineration of recyclable material, while others have opted not to regulate on this matter and rely on other (e.g. economic) instruments, or combine both approaches.

The environmental benefit argument is thus not used for defending the restriction of scope, as current knowledge does not defend that all types of paper shall be recycled in all geographic conditions and under all waste management systems. Assessments based on life-cycle methodologies suggest that the material-mixed, lowest quality paper fractions are typical examples where recycling is not a favourable option. These mixed grades also the cheapest, often entering in a price range below 40€/tonne that barely covers collection and sorting costs (which are normally 20-40 EUR/t), so the economic arguments align with the environmental, and the material is so dirty that its upgrading for recycling is not profitable, and is only attractive for energy recovery uses.

[8] Eurostat 2006 data
[9] see e.g. Merrild et al (2008), Villanueva and Wenzel (2007)

In order to ensure a correct application of the limited scope of EoW proposed, additional requirements are necessary as part of EoW criteria. The purpose of the requirements is to minimise to almost non-existence the risk that waste paper that has ceased to be waste is diverted to uses different from manufacturing of paper, be it within or outside the EU. Different options are possible for achieving this. One of them is that producers provide evidence that waste paper is destined to the manufacturing of paper, e.g. a contract with a paper mill. Another one is the set-up of a traceability system where operators in the waste paper can register. Another option is labelling, which does not ensure that waste paper is destined to the manufacturing of paper, but creates liability consequences for a producer if the labelling prescription is not respected. These options are discussed further in Chapter 4 (presentation of EoW criteria) and have been discussed with the technical working group at the workshop 23 March 2010.

With the evolution of markets and technology, one must not exclude that in the future, a clear market and demand was also identified for EoW for waste paper destined to e.g. energy recovery or compost. In such cases, the proposed criteria on fibre recycling could be complemented with a separate set of EoW criteria on waste paper for these specific purposes. If appropriate, such additional criteria could be proposed as part of EoW on refuse derived fuel, a stream essentially composed of plastics, paper, wood and textiles. Similarly, the use of paper rejects (normally paper sludge) in compost could be part of an EoW study on compost.

1.4. Structure of this document

This document consists of three clearly differentiated chapters.

The first part of the study (Chapter 2) presents an overview of waste paper, its composition, the types and sources of waste paper, its processing, grading and recycling. The chapter contains information on the fulfilment of the four conditions set out in Art. 6 of the Directive, namely the existence of a market demand and a specific use for waste paper, the identification of health and environmental impacts that may result from a change of status, the conditions for conformity with standards and quality requirements, and the legislative framework of waste paper inside and outside waste legislation. This is illustrated conceptually in the second row of the table in Figure 1.

The second part of the study (Chapter 3) presents a proposal of a set of EoW criteria, and includes the main conclusions of the discussions and consultations held with the technical working group. This is conceptually illustrated in the bottom row in Figure 1.

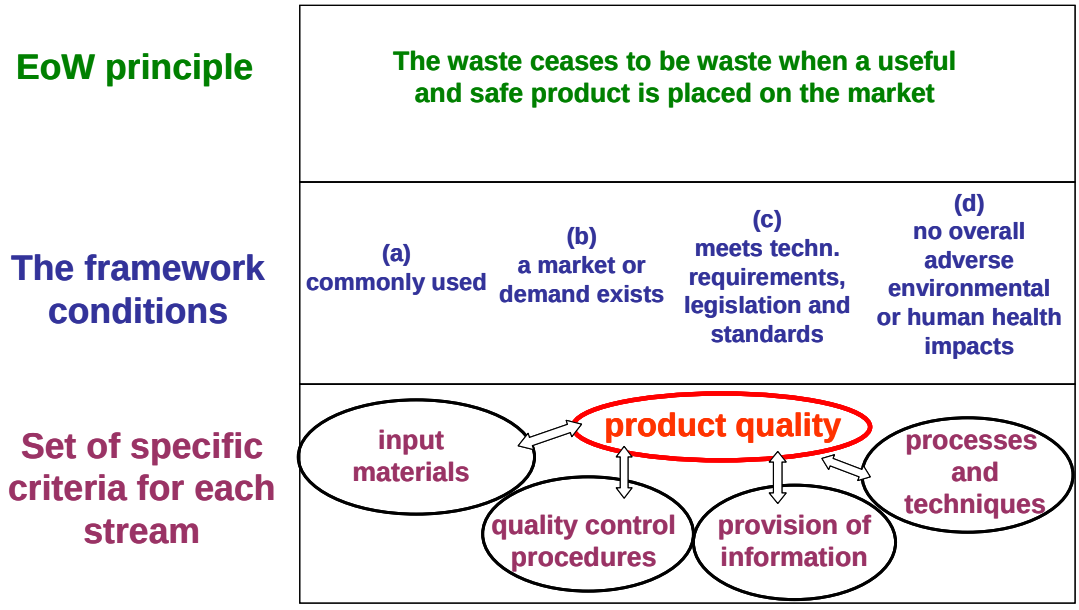


Figure 1. Conceptual illustration of the principle, framework conditions and elements of EoW criteria.

Chapter 4 describes the potential impacts of the implementation of end-of-waste criteria, as identified by the authors with input from the experts of the Technical Working Group.

Finally, Annex I presents a compact version of the proposed criteria for end-of-waste on waste paper, without explanatory text, to allow an overall perception of the set of criteria, and how the criteria depend on each other as a package.

2. Background information on waste paper reclamation and recycling

2.1. Waste paper and cardboard

Composition of paper and cardboard

Paper and cardboard are sheets of cellulose fibres with a number of chemicals, added to modify the properties and quality of the sheet. The chemicals most often used are limestone (calcium carbonate, $CaCO_3$), clay (kaolinite, $Al_2Si_2O_5(OH)_4$), and starch, all adding up in average to about 15% of the weight[10]. The content depends largely on the paper type produced, the highest loads of fillers are found in graphic papers. Chemicals are added to the fibre to provide properties such as opacity, brightness, or glossiness. A number of other chemicals can be added in much smaller amounts (normally less than 2% altogether) to obtain certain paper properties in the finished product or during processing, for instance resins, wet strength agents, optical brightening agents, sizing agents, dyestuffs, coatings, retention agents, anti-foaming agents, cleaning agents, or biocides[11]. Residual contents of chemicals used during processing, such as talc or sodium silicate from de-inking, may still be found in the paper product and consequently also in waste paper.

Cardboard is also a material composed of cellulose fibres, but fibres are here set together in a stiffer, normally thicker and less foldable structure, often with a combination of two or more layers of paper glued or pasted together for resistance in heavy-duty applications.

Cellulose fibres for paper are obtained mostly from wood, but other plants (cotton, rice, papyrus) are also used for special papers. Wood is composed essentially of cellulose and lignin, the content depending on the plant species, e.g. 25-30% lignin in dry mass in fir, pine or eucalyptus. Lignin is a natural organic polymer, and in plants it has among other functions that of cement, bonding the cellulose fibres together and providing strength. While a high lignin content makes wood durable, it has no substantial function in paper, where the target element is cellulose fibres. Moreover, the progressive chemical degradation of lignin darkens the paper, therefore it is desirable for certain applications to separate lignin from cellulose if paper is not to rapidly lose whiteness. Some paper applications with a short average life such as newsprint can handle fibres with high lignin content.

Pulp

In virgin paper production, conversion from wood to paper takes place by first generating a mass of wood fibres (pulp) using one of two technologies: mechanical or chemical pulping (sometimes combined), in so-called pulp mills.

- Chemical pulping. It is made by chemically treating wood chips to break the bonds that link lignin to cellulose, thereby allowing the separation and removal of the lignin, and the use of the cellulose fibres for paper. There are two types of chemical pulping: kraft or sulphate (basic process), and sulphite (acid process). Because lignin is separated away, chemical pulping results in a relatively low output of paper (cellulose) fibre compared to the wood input, although the liquors bearing the lignin are also used as e.g. combustible or chemical production. The process produces long fibres which provide strength to the paper, compared to mechanical processing, which would break the fibres into smaller, weaker pieces. The sulphate or kraft process is the main pulping process worldwide because it achieves superior pulp strength properties, and it can be applied to all kinds of wood species. Acidic sulphite processes degrade cellulose more than the kraft process, leading to weaker fibres.

[10] BIR (2006).
[11] JRC-IPTS, 2010

- Mechanical pulping. It is made by tearing wood fibres mechanically. For the production of mechanical pulp[12], wood is ground against a water lubricated rotating stone. The heat generated by grinding softens the lignin binding the fibres and the mechanised forces separate the fibres to form groundwood. Conversely to chemical pulping, which removes most of the lignin present originally in the wood, mechanical pulping keeps the main part of the lignin bond to the cellulose fibres, which results in a higher output of paper fibre, but a fibre with very different properties compared to chemical fibres, being shorter and containing lignin. The hydrophobic nature of lignin interferes with the formation of the hydrogen bonds between cellulose (and hemicellulose) in the fibres needed for the strength of paper, making paper from mechanical pulp less strong than from chemical pulp. Lignin degrades rapidly and darkens the paper, therefore only certain applications such as newsprint can cope with the coarse texture, lower strength of the short fibres, and colour degradation of this pulp type. During the second half of the 20th century, newer mechanical techniques using 'refiners' were developed. In a refiner, woodchips are subject to intensive shearing forces between a rotating steel disc and a fixed plate. In subsequent modifications to this process, the woodchips are pre-softened by heat (thermo-mechanical pulp - TMP) to make the fibrillation more effective. The resulting pulp is less coloured and has longer fibres.

Intermediate technologies between mechanical and chemical pulping exist. A further development of the thermo-mechanical pulp is CTMP pulp, in which the wood chips are impregnated with a chemicals treatment with sodium sulphite before the grinding. The end result is an even lighter coloured pulp, with better strength characteristics. After grinding, the pulp is sorted by screening to suitable grades. It can then be bleached with peroxide for use in higher value-added products. Mechanical pulp consists of a mix of whole fibres and fibre fragments of different sizes. Paper containing a high level of mechanical pulp and a smaller level of chemical pulp is called 'wood containing paper'

Table 1 and Figure 2 present the amounts in Mt (million tonnes) and percentages of each type of raw pulp consumed in CEPI countries[13] in 2008 (CEPI, 2009c). Most of the pulp (69% of the total) is chemical pulp, the majority if which (94% of the total chemical pulp) is produced by the sulphate process, with the remaining 6% of the total chemical pulp produced by the sulphite process.

Table 1. Types of virgin pulp (i.e. not from waste paper) consumed in CEPI countries in 2008, in Mt (million tones) (CEPI, 2009c)

[12] *Stone groundwood pulp*: pulp produced by grinding wood into relatively short fibres. This pulp is used mainly in newsprint and woodcontaining papers, like LWC (light-weight coated). *Thermo-mechanical (TMP) pulp*: pulp produced in a thermo-mechanical process where wood particles are softened by steam before entering a pressurised refiner. TMP has mainly the same end-uses as stone groundwood. Variants of the above two processes produce pressurised stone groundwood pulp and refiner mechanical pulp. *Chemi-thermomechanical (CTMP) pulp*: pulp produced in a similar way to TMP, but the wood particles are chemically treated before entering the refiner. This pulp has properties suited to tissue manufacture. Some CTMP is used in printing and writing grades. CTMP is classified under semi-chemical pulps in the Harmonised System of the Customs Co-operation Council. In the FAO, as well as in other industry statistics, such chemi-thermomechanical pulps are grouped with mechanical pulp

[13] **CEPI** (Confederation of European Paper Industries) **countries**. There were 19 members of CEPI in 2005: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland, The Netherlands, and United Kingdom. CEPI (2008) comprised 756 companies (owning a total of 1080 pulp and paper mills).

			Pulp consumption CEPI countries (Mt), 2008	Percentages
Woodpulp			47.0	
	Chemical		33.4	69 % of total pulp is chemical woodpulp
		Sulphate	31.5	94 % of chemical pulp is of sulphate origin
		Sulphite	1.9	6 % of chemical pulp is of sulphite origin
	Mechanical or semi-chemical		13.6	28 % of total pulp is mechanical or semi-chemical woodpulp
Other pulp			1.5	3 % of total pulp is "other pulp"
Total pulp			48.5	100 %

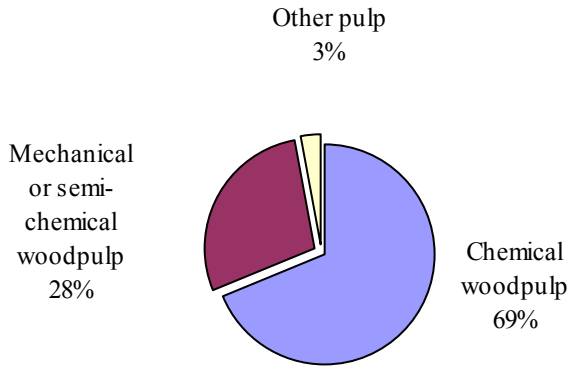


Figure 2. **Distribution of virgin pulp consumption by types in CEPI countries, 2008 (CEPI, 2009c)**

Mechanical or chemical pulp are produced in so-called pulp mills. The resulting product ('market pulp') is sold as intermediate raw material. Market pulp is then used as input, together with other raw materials and additives, in paper mills, which produce paper for final use. In Europe, most pulp mills are integrated to paper mills.

One of the main raw materials for pulp production is wood, the other is waste paper, which is a cheaper source of paper fibres than wood. Almost all pulp marketed is virgin pulp, i.e. is produced directly from wood. Only a couple of sites in Europe offer market (normally de-inked) pulp from waste paper for sale to paper mills. Market pulp from waste paper is more frequently sold as a by-product of overcapacity of recycled paper production. There is limited interest in marketing pulp from waste paper: firstly, because paper has a higher value added than pulp, and secondly and related to it, because in order to market and transport the pulp, it has to be first dried, which is an energy-intensive process. This intermediate drying is by-passed if recycled paper is produced directly.

Paper can be recycled almost indefinitely, the only drawback being a progressive shortening of cellulose fibres through processing, which reduces the strength of the resulting paper. To ensure a constant recycled paper quality, and to compensate for the constant reject of short fibres, the cycle of paper is an open cycle, which has a continuous input of virgin pulp containing long cellulose fibres. In paper plants running 100% on waste paper input, the quality loss compensation takes place by adjusting the qualities of the waste paper inputs, using waste paper of higher quality (e.g. with high content of chemical pulp) as a substitute of virgin pulp.

Paper types, paper use and recovery, and paper grades

Paper and cardboard products, be they made from virgin pulp or waste paper pulp, can be grouped into four large groups related to their uses. Table 2 and Figure 3 present the consumption of paper in CEPI countries in 2008, classified according to the use (CEPI, 2009c). The four main uses of paper, and the types of paper of each of them, are:

- **Information** (collection, distribution, storage):
  - Newspapers, coated and uncoated magazines, lightweight coated paper (LWC), supercalender paper (SC), high-grade printing paper, high-grade office paper; all these are also called "de-inking types" because they need to be de-inked prior to recycle.
- **Packaging** (transportation, distribution, protection):
  - Corrugated medium (paper, paperboard, cardboard), kraft[14] medium, testliner, liquid board packaging, carton, etc.
- **Hygienic**:
  - Tissue paper, toilet paper, etc.
- **Specialty**:
  - Filter paper, thermal paper, fire resistant papers, official papers, stamps, and an increasing number of new applications.

Table 2. Amounts of paper consumed in CEPI countries in 2008, in Mt (million tones) (CEPI, 2009c), and breakdown by use of paper.

Use of paper	Paper consumption CEPI countries (Mt), 2008	Share of total (%)
Information: graphic papers	41.7	47
Packaging	36.0	41
Hygienic: household and sanitary	6.9	8
Others: special paper, etc.	3.4	4
Total	88.0	100

[14] Kraft paper: A strong, usually brown (non-bleached) paper, processed from woodpulp, used mainly for bags and as wrapping paper.

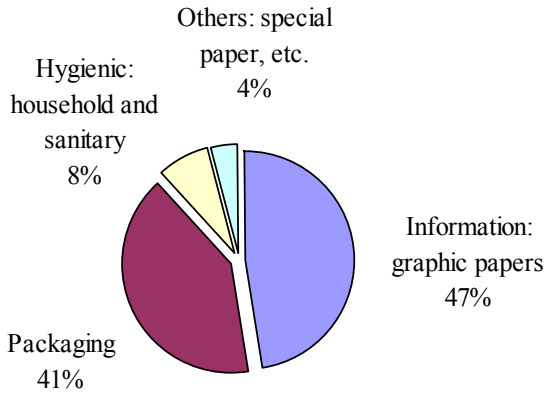


Figure 3. Distribution of paper consumption by uses in CEPI countries in 2008 (CEPI, 2009c)

Table 2 and Figure 3 clearly indicate the two large groups of waste paper applications, which are packaging paper, and information papers (printed material). As waste is a consequence of consumption, and both products have a relatively short lifetime and have dedicated collection systems after use, these two are also the major flows of waste paper in the EU.

Waste paper grades

In the context of paper recycling it is important to distinguish between ***types*** of paper, which are final use products such as newspapers, magazines, corrugated medium, tissue paper, and ***grades***, a term used for waste paper. Paper grades are classes of waste paper that define their quality and facilitate control of paper manufacturing. The concept of paper grade was introduced by the waste paper and paper-making industry to help categorize waste paper for recycling and facilitate its trade, and effectively organising its collection, sorting, and preparation as feedstock in papermaking.

A consensus process in the European paper industry led to the publication in 2000 of a list of standard grades so-called 'European List of Standard Grades of Recovered Paper and Board', later transformed into a European Standard (EN-643). This list gives a general description of 57 standard paper grades by defining qualitatively what paper type they mainly contain and do not contain, and to a limited extent the non-paper components allowed. The 57 grades are grouped in five large categories:

- Group 1: Ordinary grades
- Group 2: Medium grades
- Group 3: High grades
- Group 4: Kraft grades
- Group 5: Special grades

A detailed presentation and discussion on their characteristics is presented below in Section 2.4.

Compared to other materials like e.g. plastics, where recyclability is only possible within the same polymer type, different types of paper do not differ from each other as much. All types of paper and cardboard are made of fibres, and therefore recycling technologies for paper are similar despite differences in the paper type produced.

Sources of waste paper and its collection

Waste paper is collected mainly from three sources:

- Industrial sources; mainly paper/board manufacturing and transformation industries such as printing industry [mainly process cuttings and other pre-consumer waste].
- Commercial sources, mainly
    - supermarkets, department stores, industrial plants [mostly packaging cardboard].
    - public and private offices [mostly printed office paper and unsold magazines and newspapers].
- Households, and small businesses [mostly a mix of packaging, magazines and newspapers].

On average in CEPI countries, out of all waste paper, roughly 50% originates from industrial and large commercial sources, and the remaining 50% from households, offices and small businesses[15]. Out of this 50%, 40% stems from households and small businesses, and 10% from offices.

Until recently, apart from old newspapers and magazines, most waste paper came from industrial and commercial sources, because it was the easiest, cleanest and most economical to collect. But demand for waste paper is set to grow substantially, and additional and less cost-effective sources like households need to be increasingly tapped.

In most Member States industrial sources are collected by private companies. There are also household collections at municipalities under municipal responsibility. Sometimes municipalities have their own collection capacity, and most often the collection is subcontracted to private companies.

Waste paper from trade and industry

The collection from large industrial and commercial sources tends to provide homogenous qualities that can be classified as a specific grade in a straightforward manner. These fractions are normally delivered to processors or to mills through agreements. In these cases, processors may provide collection containers and be in charge of their regular emptying.

Waste paper from offices

Waste paper from offices, depending on the quality and amount of paper generated, can be collected separately or with household paper. Waste paper amounts to about 60-80% of the wastes generated by offices. Office paper in Europe is normally clean and homogeneous. It is still possible that there may be other waste mixed with the paper: some cans, bottles, food, etc., which is discarded with the waste paper. Homogeneous office paper has a high value, therefore companies would have normally economic benefits in sorting and selling their paper. If not willing to be involved in collection and transport to reprocessing plants, offices can normally subcontract for periodical paper collections.

Waste paper from households

Recent studies[16],[17] have revealed that household collection rates depend primarily on the people's motivation and education on the value of recycling, and also on the types of buildings, with higher collection rates achieved in more independent-living residences:

- High rise apartment houses: 51%
- Housing blocks: 66%
- Semi-detached building structures: 82%
- Detached single family: 93%

Collection from households and small businesses is generally managed by municipalities and usually involves either kerbside schemes (door-to-door collection, with different subtypes) or drop-off systems such as paper banks (also different types, and sometimes banks, reprocessing plants and bring sites refer to the same thing).

[15] CEPI 2003 special recycling statistics
[16] H. Grossmann and B. Bilitewski, "Closing the material loops: Paper recycling in Germany & Europe", Technische Universitat Dresden, 14 November 2005.
[17] Stawicki and Read (eds.),2010

Some countries collect old newspapers and magazines from households separately from paper and board packaging, others collect all sorts of paper together. Separate collection, where paper (optionally with other recyclates) is kept separate from e.g. other household waste in order to hold its quality, is considered very important for paper recycling, and will from 2015 be an obligation in EU Member States following the amended Waste Framework Directive (2008/98/EC).

While the papermaking industry prefers source and separate collection of paper, some authorities responsible for waste management opt for so-called *comingled* collection systems, where paper is collected separately from food and residual waste, but together with other recyclable materials (often plastics and metals, but sometimes also glass). In these multi-material systems, waste paper is separated subsequently from other recyclables and from non-recyclable materials (e.g. leather, textiles, ceramics, rubber) at so-called MRFs (material recovery/reclamation/recycling facilities) by the use of mechanical sorting equipment, normally combined with manual sorting.

In the EU, multi-material systems have gained popularity in Ireland (almost 100% of collection schemes), France (70%), and the UK (44%)[18] . Normally, the decision on the collection scheme is delegated to the local or regional authorities. Some municipalities in Germany have also multi-material collection schemes. In the rest of Europe, the most widespread scheme for waste paper is separate collection. The WFD encourages Member States "to promote high quality recycling and, to this end, set up separate collection where technically, environmentally, and economically practicable and appropriate" (Art. 11)

Waste paper grades can never economically be produced 100% free from non-paper components, as the reliance on the source to segregate to that level is improbable, especially from households. Moreover, subsequent sorting to a 0% impurity content level could perhaps be technically possible, but probably be uneconomic. However, it seems correct to ascertain that multi-material systems tend to result in the output having higher levels of non-paper components if the process is not running well or is overloaded, and it has been proven by sampling studies that on average multi-material systems generate waste paper that has not as higher quality as that stemming from separate collection, mono-material systems. For this reason, CEPI has published a document summarizing guidelines for responsible sourcing of paper (CEPI, 2006), discouraging e.g. comingled collection.

However, while additional cleaning costs are met by the papermaking industry, authorities responsible for waste management generally save direct costs with multi-material collection systems, an argument which, together with the perception that multi-material collection is easier for households, has made many authorities move to use e.g. comingled waste collection systems. No conclusive evidence has yet been gathered on a comparison of the overall socioeconomic costs of both systems (WRAP, 2008).

Specific paper types found in households and which are detrimental to production or of no use in some paper mills are:

- Tinted paper, e.g. in yellow pages or reminder stickers (e.g. post-it). These are paper types where the fibre has been dye-coloured, and are detrimental for some papermaking such as the de-inking grades, as these types of dye are difficult or impossible to remove. Production of paper that does not need deinking (e.g. card) is more tolerant to the presence of dye-coloured paper. Other possibilities for their management include energy recovery, reuse, donation, or reselling.
- Paper containing wax or adhesives such as stamps, stickers, tape.
- Multi-material paper: e.g. wrapping paper with gold and silver dyes.
- Multi-layered, composite paper/metal/plastic, frequently used for food and beverages, e.g. liquid board packaging, or for avoiding humidity intrusion and increasing strength, e.g. coated sacks. Liquid board packaging are made of a composite material consisting of paper (75%), plastic (20%), and aluminium foil (for long-life products, 5%), and are recyclable in compliance with Directive 94/62/EC on packaging and packaging waste. Depending on the mill, these materials can be useful, or not. Most papermills cannot extract the paper fibres from these composites, and the whole composite ends in the reject from the pulper. Only plants equipped with specialised processes that delaminate the packaging

[18] Source: CEPI, 2009

by longer pulper residence time or pre-treatment are able to separate the aluminium and polyethylene foils, and use the paper fibres. The non-fibre remainder is normally landfilled or incinerated, but can in some cases be used for garden furniture, roofing plates, or as insulation material. New plasma technology is being developed in an attempt to enable the total separation of the polyethylene and aluminium, which would allow the return of all three components of the beverage carton to the productive chain as raw material.

Waste paper and its use

In terms of grades, waste paper can be classified as follows (c.f. also Table 3):

- Groups 1 and 2. Ordinary and Medium Grades. Approximately 50% of the collected waste paper.
- Group 3: High grades. Approximately 10% of the collected waste paper.
- Group 4: Kraft grades. Approximately 40% of collected waste paper.
- Group 5: Special grades. Negligible amounts compared to the other standard grades.

Groups 1 and 2 papers are largely used as packaging and newspaper types, and are the bulk of paper collected from households and commerce. It is interesting to notice the low percentage of waste paper which is classified as 'high grade'. High grades have a high level of homogeneity and quality and stem from separate collection in e.g. businesses and industry. The sources of this material are fewer compared to mixed sources, and high grades are normally kept separated from other fractions, and require little sorting.

An illustration of the mentioned uses is provided in Figure 4, including Table 3 with a detailed breakdown. The paper grades are in these figures divided into four main groups, which are frequently used for commercial and statistical purposes. The correlation to the five groups of the EN-643 is as follows:

- Mixed Grades: 1.01, 1.02, 1.03, 5.01, 5.02, 5.03, 5.05
- Corrugated and Kraft: 1.04, 1.05, 4.01, 4.02, 4.03, 4.04, 4.05, 4.06, 4.07, 4.08, 5.04
- Newpapers and Magazines: 1.06, 1.07, 1.08, 1.09, 1.10, 1.11, 2.01, 2.02
- High Grades: 2.03, 2.04, 2.05, 2.06, 2.07, 2.08, 2.09, 2.10, 2.11, 2.12, 3.01, 3.02, 3.03, 3.04, 3.05, 3.06, 3.07, 3.08, 3.09, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.17, 3.18, 3.19, 5.06, 5.07

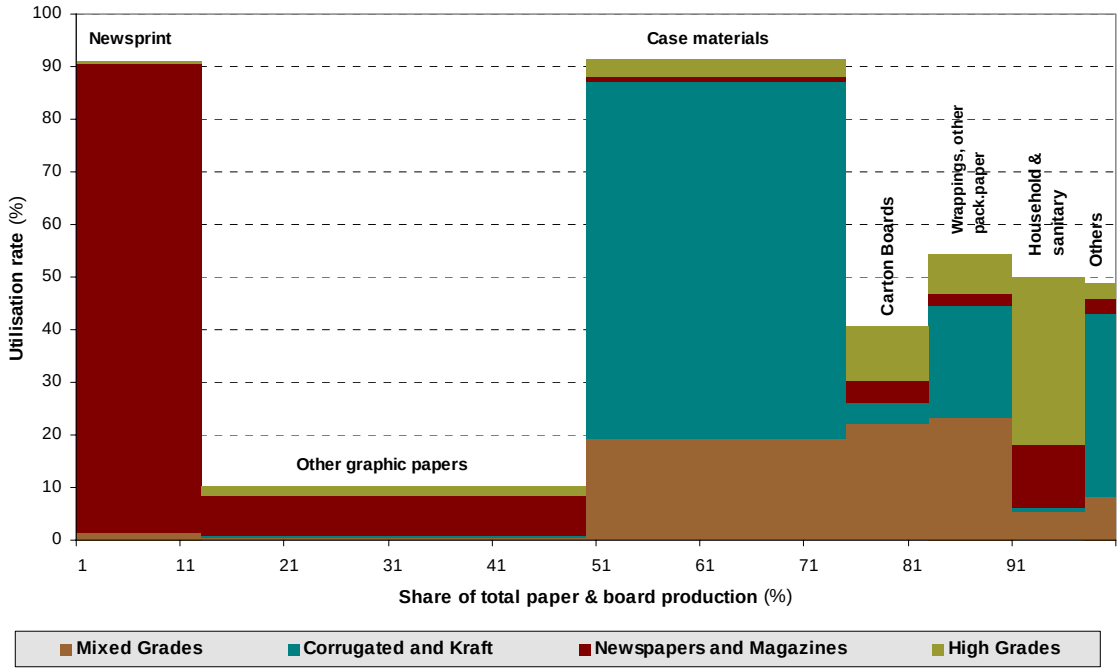
In Figure 4 it is noticeable that to make recycled printing and writing paper, it is not possible to use mixed grades, but only some de-inking grades and higher grades, complemented with virgin fibre. On average, paper for printing applications other than newspapers requires high quality fibres, therefore it has a lower content of recycled fibres when compared to other types of paper.

The packaging sector is the biggest consumer of waste paper - almost two thirds of waste paper is used to produce case materials, folding boxboard, wrappings and other packaging materials.

Waste paper utilisation rates are very high in some packaging grades - about 90% in case material production for example. Packaging paper and household and sanitary papers are to a large extent based on waste paper too – both with utilisation rates above 50% with.

On the other hand, in the family of printed material only the de-inking grades hit large utilisation rates (90%), while the rest of graphic papers, that represent almost 40% of total paper and board production, use limited volumes of waste paper and mostly rely on virgin fibres. Tapping this potential is however difficult, as no systems are currently in place for collection of high quality material from the so far untapped sources (households). Other area of high potential increase of recycling is the use in household and sanitary applications, this potential largely depending on consumer's perception of the use of recycled fibres in these products.

The figure illustrates two clearly split recycling cycles – not closed loop but nearly – one for recycling of printed products in newsprint (mostly mechanical fibre, requiring de-inking), and one for recycling of "brown" fibre for card (mostly chemical fibre, non-bleached). These two cycles comprise the bulk of the recycling flows. It is also evident that clean, bleached chemical fibre waste paper (high grades) can be used for all papermaking purposes.



Recovered Paper Utilisation by Sector in CEPI Countries in 2008

Paper Sector	Recovered Paper Grades							
	A	B	C	D	E	F	G	E:G
	Mixed Grades	Corrugated and Kraft	Newspapers & Magazines	High Grades	Total Use of Recovered Paper	Usage by Sector *	Total Paper Production	Utilisation Rate **
'000 Tonnes						%		%
Newsprint	141	0	9.444	52	9.637	19,8	10.586	91,0
Other Graphic Papers	245	12	2.807	723	3.787	7,8	36.927	10,3
Total Newsprint + O.G.P.	**386**	**12**	**12.251**	**775**	**13.424**	**27,6**	**47.513**	**28,3**
Case Materials	4.608	16.309	289	723	21.929	45,1	24.038	91,2
Carton Boards	1.829	328	349	848	3.354	6,9	8.250	40,7
Wrappings, Other Pack.	1.864	1.715	168	600	4.347	8,9	8.007	54,3
Total Packaging Papers	**8.301**	**18.352**	**806**	**2.171**	**29.630**	**60,9**	**40.295**	**73,5**
Household & Sanitary	**370**	**59**	**797**	**2.162**	**3.388**	**7,0**	**6.759**	**50,1**
Others	**370**	**1.540**	**128**	**136**	**2.174**	**4,5**	**4.435**	**49,0**
Total	**9.427**	**19.963**	**13.982**	**5.244**	**48.616**	**100,0**	**99.002**	**49,1**
Share of Total	**19,4%**	**41,1%**	**28,8%**	**10,8%**	**100,0%**			

Source for EU Non-CEPI Countries: Jaakko Pöyry Consulting

**Usage by sector: total use of recovered paper in a sector as % of the total recovered paper used by the industry*

*** Utilisation rate: use of recovered paper in a sector as % of total paper production in that sector*

Figure 4 and Table 3. Waste (*recovered [sic]*) paper utilization by sector in 2008 in CEPI countries, and detailed breakdown of the cross-use of waste paper grades for manufacture of different paper types. Source: CEPI, 2010

Out of the total volume of waste paper collected, the following products are the outputs of paper mills:

- 63% packaging applications
- 27% information applications:
    - 19% newspapers
    - 8% other graphic papers
- 7% hygienic and household uses
- 3% other uses

In summary, most of the waste paper is used in packaging, followed (by a significant difference) by information applications, herewith mostly newspapers.

Paper is made from waste paper especially for newspapers and packaging materials (above 80% of input material), the use of waste material being low (under 10%) for other graphic papers, and medium (40-60%) for all other types of papers (including carton boards, wrappings, household and sanitary).

Statistics on production, use, reclamation and recycling of paper

Table 4 and Figure 5 reproduce CEPI statistics on paper production, consumption, recovery, and recycling in 2005 in CEPI countries (CEPI, 2006b). Even though these statistics refer to CEPI countries, they can be used as a representative guide to typical paper waste statistics in Europe. Figure 6 completes this table by illustrating the evolution (1995-2008) of waste paper utilisation, trade and recycling.

As summarized in Table 4 and Figure 5, in 2008, paper and board production in CEPI countries was 100.8 Mt[19], from which CEPI countries consumed 90.6 Mt. In the same period, from the total consumed amount, 60.4 Mt were collected. Of the remaining 30.3 Mt, about 6 Mt were incinerated, 0.4 Mt were composted, and 22 Mt went to landfill disposal and other treatments.

Table 4. Statistics for paper production, consumption, collection, and recycling in 2008 in CEPI countries (adapted from CEPI, 2010) [20] (Mt = million tonnes)

Indicators	**Amounts/percentages**
Paper Production (A)	99.002 Mt
Paper Consumption (B)	87.444 Mt
Waste Paper Collection (C) herewith pre-consumer	58.995 Mt ca. 9Mt
Waste Paper Utilisation [recycling] (D)	48.616 Mt
Waste Paper Net Trade (NT=C-D))	10.379 Mt
Utilisation Rate (D/A)	49.6%
Recovery Rate ((C-Landfillling-Non-collectable)/B)	43.1%
Recycling Rate (D/B) Recycling rate (incl. net trade): (C/B)	55.6% 67.5%

[19] CEPI, 2006b

[20] **Definitions:**

Paper Production: Paper that is manufactured by the list of countries. Some of it is unsold, some of it is sold in the market within the list of countries, and some of it is exported.

Paper Consumption: Paper that is delivered (purchased) and used within the list of countries, plus imports from countries outside the list of countries.

Waste Paper Collection: Separate collection of paper from industrial, commercial, households, and offices, with the purpose of its recycling.

Waste Paper Utilisation: Use of waste paper as raw material; i.e., waste paper of any kind put into the pulper at the paper mill.

Collection Rate or Recovery *[sic]* Rate: Percentage of waste paper collection compared to the total paper consumption

Utilisation Rate: Percentage of waste paper utilisation for making new paper, compared to total paper production (by all sources: using virgin plus waste fibres).

Recycling Rate: Percentage of waste paper utilisation for making new paper, compared to the total paper consumption. CEPI includes the net trade into this definition, substituting the collection rate, which is no longer published.

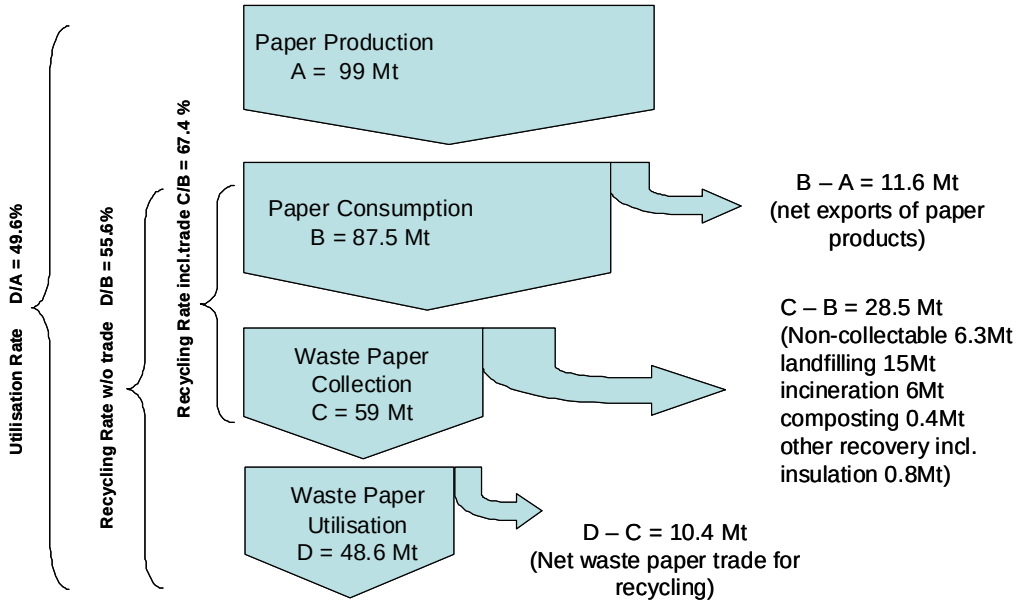


Figure 5. Flow diagram of paper production, consumption, collection, and recycling in 2008 (data from CEPI, 2010). (Mt = million tonnes, rounded figures)

CEPI and the European Recovered Paper Association (ERPA) had jointly signed and launched in 2000 the European Declaration on Paper Recovery, pledging that by 2005, 56 (±1.5)% of the paper and board products used in Europe would be recycled. With the recycling rate of 55.4% reported in 2005 and , CEPI countries already achieved their voluntary recycling target[21].

The latest paper statistics report that the collection rate achieved in 2008 a level of 66.6%. The steady increases in collection and recycling rates in Europe are displayed in Figure 6.

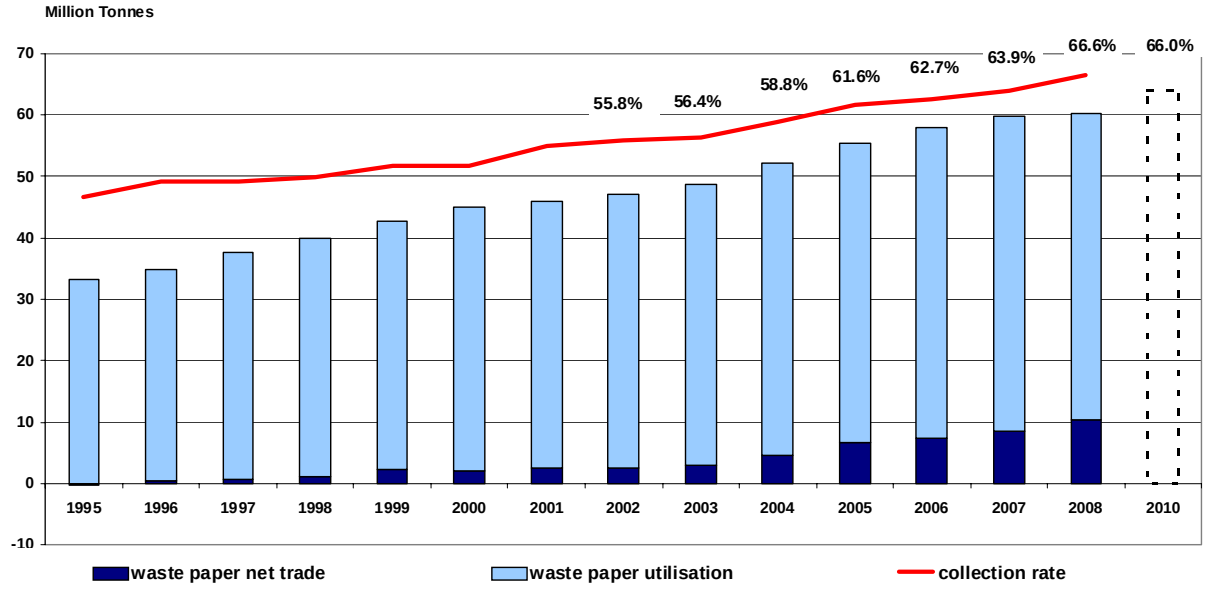


Figure 6. Trends in European (EU27+NO+CH) paper collection and recycling, from 1995 to 2008.
SOURCE: European Recovered Paper Council, 2009

[21] (Source of data and [sic]-marked definitions: CEPI, 2009).

The high collection rate of 66% is an average for countries, and in 2008 ranged from about 35% to more than 70%, depending on the country. Countries with the lowest collection rates are nevertheless catching up rapidly: in these countries it is economically more feasible to increase collection and recycling rates whereas countries with high rates have already tapped most feasible paper sources.

There appears to be an agreement that it is very difficult to achieve collection rates much higher than approx. 70%, which has already been achieved in Finland, Germany, Sweden and the Netherlands. More specifically, there is an amount of ca. 20% of all the paper on the market, which is non-collectable (archives, wall paper, bank notes, libraries), or non suitable for recycling (hygiene and tissue paper, some types of food packaging, etc.) which is transferred to landfills (5-6%), incinerators or other waste treatment systems. Specific statistics are available on beverage packaging, indicating that in 2008 about 1M tonnes were produced in the EU and 350,000 tonnes were recycled (EU-27 plus Norway and Switzerland), compared to 6,000 tonnes recycled in 1992.

According to some sources, the percentage that is believed to be non-collectable is close to the mentioned 20%. In addition to non-collectable and non-recyclable paper, it may not be economically or environmentally sound to collect and recycle everything that, in theory, would be technically feasible because this could require extra costs such as increased transportation.

Generally, there is a lack of data on collection, collection rates and recycling rates by specific grades of paper (for example, for office printings, or for newspapers, etc.), partly due to the fact that many of the waste paper streams consist of mixtures of different types of papers. Moreover, due to the nature of recycling of paper fibre, where cross-uses of different grades are possible, grade-specific information has so far not been demanded as actively as in other materials such as plastics, where such cross-use is very limited by the nature of polymers. Disclosed information would be very useful, but aggregated figures for total waste paper collection and recycling have so far been found sufficient by most analysts for describing the evolution of waste paper management. The disadvantage of this approach is that it is difficult to know the desirable collection and recycling targets for a given product or application, and it is also difficult to know how much progress has been made in increasing collection and recycling rates for given applications or types of paper. Nevertheless, some information is available (see Figure 4) on specific paper types such as liquid board packaging[22].

Short-term and long-term trends in paper waste generation, collection and recycling

There are different views on the future trend of paper use. As early as the 1970s, with the introduction of computers, some predicted the end in the use of paper in offices, and the advent of the so-called paperless office (Business Week, 1975). Contrary to this prediction, the introduction of computers has doubled the use of paper worldwide from 1980 to 2000, largely due to economic development and the expansion of activities using paper. Some reasons for this increase in consumption of paper can be attributed to the increased easiness in producing documents, improvements in technologies for printing and photocopying, etc. In packaging, there are also opposing trends: an increase in its use for food handling and distribution, but also an increased collection rate. Uncertainties remain on this topic.

Some recent concrete examples of possible decrease in consumption of paper products have been reported in the UK[23] and the US, where collection rates dropped because citizens are buying fewer newspapers and magazines. Possible factors are the more widespread use of the internet to read the news, and the effect of the economic crisis. Reduced paper consumption in the future could also be due to a contribution of other factors, such as increased waste minimization efforts in many communities, the use of fewer materials for packaging, and other efforts. In other countries (e.g. Spain), stabilization or increase in consumption has

[22] Some specific paper type sectors publish specific statistics, for example the Alliance for Beverage Cartons and the Environment (ACE) annually publishes the recycling rate of beverage cartons in Europe: (www.beveragecarton.eu). This data is collected partly due to legal requirements in some Member States: there is a legal recycling target for beverage cartons in Austria, Belgium and Germany."

[23] WRAP, 2009

been witnessed in the early and mid 00's, among others due to the expansion of door-to-door free magazines and ads, and free newspapers in urban areas.

Despite the mentioned factors keeping paper consumption down, the paper industry expects that the overall world paper demand will increase by 25% by 2020[24]. Paper competes today with other materials for packaging and information including modern electronic information media and advanced plastic and composite packaging materials, and therefore a decrease in the production of paper waste is not expected.

2.2. Technologies for paper collection and recycling

Almost any type of waste paper can be recycled[25], but processing is hindered or even made impossible if waste paper has been in direct contact with other waste, most notably hazardous waste, health care waste, household waste, or food waste, or if waste paper contains materials that are difficult to separate, e.g. oil, or adhesives. Therefore, paper mills generally consider essential that waste paper comes from sources where it is kept separate from the mentioned waste types, as contaminated papers are not acceptable for paper manufacturing both for technical reasons (waste contaminants are difficult to remove as equipment is not prepared to receive it) and health and safety reasons (presence of pathogens and odours).

Currently, collection for recycling handles most paper categories, including used newspapers, cardboard, packaging, stationery, postal mail, magazines, catalogues, greeting cards or wrapping paper, in most cases originated in separate collection systems.

Used paper and cardboard are collected for recycling by municipal or private organizations, and delivered to reprocessing plants. Reprocessing plants sort paper into grades, and can be independent or located in the immediate vicinity of paper mills, sometimes as separate companies, sometimes integrated. In recent years, some paper mills have bought collection companies in order to ensure themselves control of the quality and amount of the supply of waste paper used as input materials. For close-located sites, transport can take place through conveyors or as bulk material, but for long distances it is most common to pack waste paper in bales. Graded waste paper (normally baled, sometimes bulk) is fed directly to paper mills, which produce different paper and cardboard types as final use products. As mentioned above, recycled pulp production not integrated to paper production is almost non-existent, so recycled pulp is seldom traded as a market product.

Waste paper reprocessing plants: sorting, cleaning, grading, baling

Waste paper can either be sorted at source, or disposed of mixed with other household, office or commerce waste. Waste paper from industry is in most cases homogeneous and sorted. Waste paper mixed with household, office or commerce waste can be sorted mechanically, but in general the quality of the paper sorted this way is not as high as from separate collection systems, and is only suited for applications that tolerate a certain degree of cross-contamination. Sorted waste paper is sent to reprocessing plants, where it is compressed and often baled, graded, and finally delivered to a paper mill for paper production. Baling is sometimes by-passed for convenience, particularly between reprocessing and papermaking sites that are geographically close.

During dry sorting in the reprocessing plants, some detrimental material such as large plastics, metals, wood, or glass, can be removed mechanically, optically or by hand-picking before compacting and baling. The extent of removal depends on the destination of the paper and the location in the paper chain of the sorting operations. Reprocessing plants determine the extent of non-paper components removal required depending on the price they can get for the consignment with or without further non-paper components removal. Obviously, consignments with different homogeneity in the content and different levels of contaminants have different prices. Different equipment and hand-picking staffing allows for a more/less effective sorting of streams e.g. mixed paper from kerbside waste paper containers can be sorted into newspapers, cardboard, grey paper and, a non-paper stream.

[24] Cost E48 (2008)
[25] www.paperonline.org

The admissible content of unusable materials is defined in the contract between the processor and the buyer (another reprocessor or a paper mill). Normally, paper mills are equipped with separation technology of some kind, and this determines the threshold of acceptable unusable materials. In some cases, reprocessors can choose to keep a degree of non-paper components and save a clean-up step against obtaining a lower price for the consignment.

As mentioned above, the bulk of waste paper in Europe originates from separate collection at source, including industrial sources (e.g. printing industry), offices (private and public), large commercial businesses (e.g. supermarkets, furniture) and households (bring or door-to-door collection). Paper mills have contracts with one or more own or external reprocessors for the supply of waste paper of an agreed quality. This quality may not make reference to a standard (e.g. EN-643 in Europe), but it often does.

Some sources generate paper that is of a homogeneous quality and does not need further sorting (e.g. many industrial sources such as non-sold newspapers, shavings from printing industry). Sorting is necessary in household and commercial business paper. Often used techniques for sorting include:

- Automated physical separation, which relies on differences in physical properties such as size, stiffness, colour, composition, and weight of paper and its non-paper components. For example, cardboard can be separated from paper because usually cardboard pieces are physically larger and stiffer than paper. An example of automated physical separation is the "ballistic separator". Here, the sorting machine consists of a belt of rotating wheels, sometimes covered with brushes: the larger and stiffer pieces of cardboard are moved horizontally and forward, while the smaller and more flexible pieces of paper (e.g. A4 size) fall through spaces between the wheels. The speed and spacing of the wheels is adjustable.
- Visual manual sorting: Operators manually separate different types of paper, usually after a previous mechanical separation stage.
    - Manual negative sorting: This is the most common manual sorting, and it is done by removing unusable materials.
    - Manual positive sorting: Less common, it consists of manually picking up the materials to be reclaimed from the waste stream.

To save costs and gain efficiency, automatisation of sorting is gaining its space in reprocessing, usually hand in hand with quality management systems. Advanced techniques such as optical sensors (high-resolution colour camera; CMYK - cyan, magenta, yellow and black sensor, NIR – near infrared sensor) and image processing and pattern recognition methods have been applied since around 2002 in Germany[26]. These are combined with separation techniques including spikes and air stream sorters, which enable the sorting of graphic paper for de-inking from mixed qualities, or brown from gray boxboard, and which can sort out dyed papers and contraries (the entire spectrum of materials including e.g. plastics and laminated paper). Some advantages of using optical recognition systems for waste paper sorting are:

- A high level of purity of the de-inked fraction;
- Recognition of paper and non-paper components;
- Remote maintenance, system monitoring and system service can be carried out in part by the manufacturer via the Internet.

Drawbacks include:

- Technical complexity limits in-house maintenance possibility;
- Incoming material must be prepared by coarse and fine screening;
- Recognition only on one side, therefore, with one-sided white packaging paper, there will be 50 percent mistaken categorization;
- Relatively high capital costs;
- High energy and operating costs (power and compressed air);

[26] "What works? A German study, presented at Recycling Today's 2006 European Paper Recycling Conference". This paper examines how sorting technology is being deployed in the recovered fiber section in Germany: http://goliath.ecnext.com/coms2/gi_0199-6092249/What-works-A-German-study.html

- Limited speed of the conveyor (2.8 m/s), as certain paper components "start to fly" at higher conveying speeds.

The extent to which cost-intensive technical solutions such as optical systems or air stream sorting will become more widespread depends on several factors. Short contract periods for collecting and sorting waste paper as well as high prices for non-sorted material make investment in sorting techniques risky. However, if waste paper processing rewards a more consistent and better quality, such investments will be easier.

Operations at the paper mill

When waste paper arrives at the paper mill, it is inspected against the terms of the contract (weight, grade, moisture and unusable material content), always by visual inspection, and if needed by analysis. Some mills run analyses on all incoming material, some only on consignments identified visually as non-compliant. If baled, material is de-baled, and if needed, foreign objects are sorted out. Normally, paper is then mixed with other paper grades and/or pulp sheets to obtain the desired 'receipt' or combination of input qualities[27].

Two large operations take place subsequently: pulping and papermaking. Pulping can be composed of a number of unitary operations (their need varies with the type of paper or cardboard produced), and include cleaning and screening, deinking, washing, and dispersing. Pulp can optionally be subsequently bleached.

In pulping, raw materials are diluted with up to 100 times their weight of water and mixed mechanically using steel rotor blades. Paper pieces are gradually chopped and dispersed in water to form a slurry. Chemicals are then added to adjust the pH. The slurry flows to screening, where foreign materials are removed. Metal straps and staples can be screened out or removed by a magnet, and hydrocyclones reject materials more dense that paper fibres. Screens, with either slots or holes, are used to remove respectively the contaminants larger than pulp fibres from the fine materials and short fibres.

An increasing supply of waste paper grades with higher non-paper components content has been witnessed in the last decade, e.g. originated from tapping household and SME sources following EU packaging directive targets and from the increasing number of comingled collection systems. Adapting to this supply, a growing number of mills have adjusted their technology to accept such grades, and the range of incoming grades which mills are able to treat is increasing as technology develops.

Materials which currently are more difficult to remove include wax coatings and adhesives, moisture – repellent materials, soft rubbery particles, and glass powder, which is highly abrasive to machinery, can make deposits, and contaminate the recycled paper. Adhesives originate from book bindings, stickers, envelopes, labels, adhesive tapes, etc.

Recycled fibres can be divided into two broad categories: printed, and non-printed. If waste paper is printed and the final product is sensitive to the colour resulting from ink, a de-inking stage is needed, with different associated pre-treatment and recycling technologies. In the deinking stage the goal is to release and remove the hydrophobic contaminants from the paper pulp. Several processes are used, most commonly flotation or washing. The detachment process is heavily affected by the age of the waste paper, i.e. how old is the ink and how long it has been in contact with the fibre.

Wash deinking consists of a washing stage where dispersants are added to wash out the printing inks. When the pulp slurry is dewatered (thickened), the medium to fine particles are washed out. This process is most useful for removing particles smaller than about 30 μm, like water-based inks, fillers, coating particles, fines and micro adhesives. This process is more common when making deinked pulp for tissue. The processing equipment are belt filters, pressure belt filters, disk filters and static filters.

Flotation deinking is the most common deinking process in Europe. Air blown into the pulp suspension where a collector is added, which because of its affinity both to the ink particles and air bubbles, causes air

27 For details on the recommendations, see CEPI's "Recovered paper quality control guidelines"

bubbles lifting the ink to the surface, forming a thick froth that can be removed. Flotation deinking is very effective in removing ink particles larger than about 10 μm.

Subsequent washing and dewatering (thickening) in filters remove small particles (< 5 μm) from the pulp. A number of chemical operations can follow, e.g. chelants may be added to prepare for bleaching, where peroxides or hydrosulphites can be added to increase the brightness of the pulp.

In subsequent papermaking operations, auxiliary chemicals may be added, including sizing agents, which reduce ink and water penetration, anti-foaming agents, or clay, chalk and titanium dioxide for controlling glossiness and opacity. In dyed paper, dyes can be added to the pulp. Further, water can be added to produce a thin fibre suspension which is fed on to rolls in a moving, endless mesh. Water is then removed again by gravity and/or suction to form sheets of intertwined fibres on top of a wire mesh. This web of wet paper is then squeezed between a series of presses where its water content is lowered to about 50%, and passes around cylinders heated to temperatures in excess of 100ºC to dry further to a final water content between 5% and 8%. The webbing and drying use mould shapes other than cylinders if the final product is not flat (e.g. egg trays).

After drying, some papers may undergo surface treatments e.g. sizing and calendaring to smoothen the surface of the paper. The paper is then wound into a reel.

The rejects from pulping and papermaking are sludges and mixtures of inorganic and organic material, which usually have to be disposed of (landfilling, incineration at waste incinerators, cement kilns or own combustion for energy) or composted, and amount to about 1.8% dry weight (15-40% in wet weight, depending on the pulping and deinking process) of the input of raw material. Sanitised sludge free of plastics and metal is sometimes spread on agricultural land (INFU/Prognos, 2009).

One of the technological challenges of papermaking is the spread of flexo and digital printing technologies. Flexo-printed newspapers and magazines and pigmented inkjet printed paper, which use water-based inks, cannot be deinked to a quality that is suitable for papermaking. These waste paper types are currently still very difficult to identify and sort out of the waste paper consignments, and a small amount can make all the material unsuitable for applications that require deinking. R&D into new inks and deinking techniques are now a major priority for the industry.

2.3. Economic and market aspects of paper recycling

Markets and market structure

Global paper and board production grew from 239 Mt (million tonnes) in 1990 to almost 369 Mt in 2005[28]. In these years, capacity for papermaking from waste paper has increased and the market has in general be limited by supply. Once the worse parts of the stagnation effects of the financial crisis of 2008 were hurdled, demand for waste paper has been re-established, the slowing demand growth in North America and Western Europe being counterbalanced by sustained growth in Eastern Europe, China and the rest of Asia. The highest consumption growth rates are likely to be seen in tissue, corrugating materials and wood-free papers.

Production of paper and board follows closely consumption. It is expected that the share of global production taking place in Western Europe, North America and Japan will fall from 62% in 2005 to below 50% in 2015, not because of less production in absolute terms, but because of a smaller share in faster growing economies.

In 2005, the raw materials used to manufacture the 369 Mt of paper and board produced for consumption worldwide comprised 186 Mt of waste paper, 188 Mt of primary fibre, mainly wood pulp, and about 50 Mt

[28] WRAP, 2007

of minerals and fillers. This implies a loss of about 50 Mt of raw material during processing (including fines, sludge, moisture, unusable fibres).

In most Member States, collectors and reprocessors are private companies, operating under permits. There are on the one hand “waste management" companies, some of them multinational, which collect large volume of waste paper as well as other wastes. In addition, within the EU many small size specialized companies participate in the collection, transport, recovery and recycling of waste paper, each normally having a niche of waste paper grade specialisation, some having sorting equipment, some being essentially merchants. Although usually public organizations are not active in waste paper export and trading, mostly carried out by private sector operators, in some countries some public bodies and even paper mills export waste paper that can not find national outlets, be it because of low domestic demand or for commercial reasons.

A trend is observed in the last years towards purchase of collection and reprocessing companies by papermaking companies, in order to better control the quality and quantity of supply. Other arguments play a role, e.g. it is less expensive to invest in dry sorting than wet (pulper) sorting. However, most of the waste paper reprocessing companies in the EU are not integrated to paper mills. Integration depends also on the type of paper produced: some newsprint and board producers have bought reprocessing plants, but in general packaging and tissue producers seem more reluctant to invest in the reprocessing sector.

International trade in waste paper and paper products

The total volume of world trade in waste paper was approximately 42.3 Mt in 2005[29]. This means that about 23% (of the total 186 Mt of waste paper) was traded internationally, and 77% was consumed in the country in which it was collected. An illustration of trade in 2004 is given in Figure 7, and a specification of the trade balances in different CEPI countries is provided in Figure 8

In 2005 there was a net export of about 24 Mt of waste paper from Western Europe, North America and Japan to China, other Asia and the rest of the world. This net export is expected to further strongly increase. The reasons include (a) that North America and Europe have well developed and highly productive forest industries, while China and East Asia have very limited forest resources, (b) collection rates in the EU have increased gradually, and (c) there is an inverse relationship between the regional trade balances in manufactured goods and the trade balances in waste paper (and other recyclable materials): the packaging and printed material associated with goods imported into North America and Europe becomes available for collection in the countries where the goods are used. These materials are highly demanded again by the large good exporters, with a growing waste-paper based paper production industry, for their use as packaging, and can be traded back either as waste paper or as final paper commodities.

[29] WRAP 2007

Fig 7. Major global trade flows of waste paper, 2004. Source: CEPI, 2006c

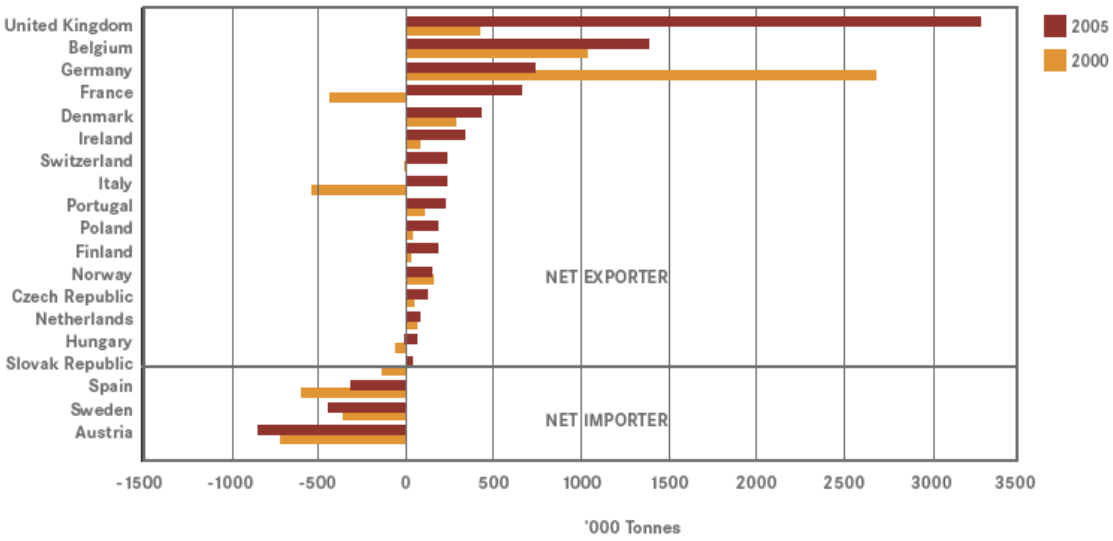


Figure 8. Waste paper trade balances by country in 2000 and 2005. Source: CEPI, 2006c

In the mid 1990s, Western Europe turned from being a net importer of waste paper into a net exporter. The reason was mainly the increased collection and the consolidation of the higher demand from outside the EU. The region's surplus declined between 2000 and 2003 when massive new investments in production capacity from waste paper fibre were made. Improved collections in countries such as Italy, France and a number of smaller countries have led to an again growing surplus after 2003. France turned from a net importer to a net exporter in 2003 and Italy in 2004. The UK has traditionally been a net exporter of fibre from waste paper, although in the past the net export surplus was rather small. It was only in late 2002 that exports started to increase very rapidly.

China has rapidly developed into the world's largest importer of waste paper fibre (see Figure 9), followed by far by the rest of countries. Among other purposes, it imports fibre from waste paper which it then exports as packaging in its large product export surplus. Chinese imports of waste paper have grown from less than 0.5 Mt in 1990 to over 17 Mt in 2005, following the demand for paper production. North America

is the main source of Chinese imports (47% in 2005), followed by Western Europe (27%) and Japan (18%). Old corrugated containers (Grade 1.05 in Table 5) and kraft grades are today the largest import grades in China. But also mixed paper grades imports have increased. It is noteworthy that demand of paper fibre in China, India and Indonesia has been healthy during the 2008/2009 economic crisis[30], when European demand has been stagnant and in some cases non-existent, shifting the destination of European waste paper.

In 2005 the CEPI countries with the greatest net export of waste paper were the UK (3.2 Mt), Belgium (1.4 Mt), Germany (0.7 Mt) and France (0.6 Mt), see Figure 8. The only net importers among CEPI countries were Austria (-0.8 Mt), Sweden (-0.5 Mt) and Spain (-0.3 Mt). In 2000 Germany was still the CEPI country with the greatest net export, the UK net export was less than 0.5 Mt, and both Italy and France were net importers. Exports to China represented more than 60% of total waste paper exports by CEPI countries in 2005.

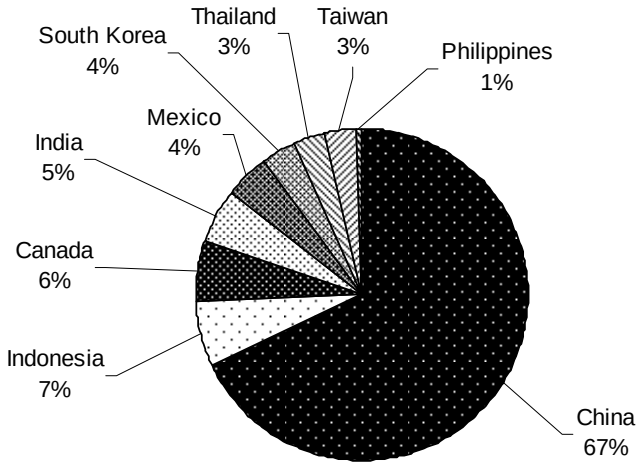


Figure 9. Main world waste paper importers, 2007. Source: Magnaghi/BIR (2008)

Prices

The prices for waste papers are largely determined by the price of finished paper and cardboard and the products[31]. Unlike other materials like metals or plastics, waste paper has not experienced large price increases. However, these other materials are part of products which normally have a much higher added value, whereas waste paper is almost solely (c.f. scope definition) used to produce paper and board, in general in products with low added value. Other elements influencing waste paper prices are:

- Availability - which depends on the collection scheme, and the patterns of consumption;
- Quality – depends on the collection scheme and the technology for separation;
- International demand of paper products;
- International demand of waste paper, trade quotas, shipping costs;
- Price of virgin pulp and timber price;
- Legislation constraints – administrative burdens, pollution abatement requirements for paper production;
- Costs of alternative outlets to recycling.

Starting from collection, the purchase costs can be positive or negative (meaning the collection origin has to pay for collection and recycling), depending on the purchase contract, some including price guarantees

[30] BIR (2009) BIR world mirror – recovered paper Quarterly report, April 2009. BIR, Belgium
[31] Magnaghi, G. (2008), The world recovered paper market in 2007. BIR, Brussels, 2008.

(e.g. large commercial sources). As long as the costs of the alternatives (landfill/incineration/other) exceed the costs of waste paper collection and reprocessing, there is an economic basis for waste paper recycling.

In most cases the profit margin and the net price (free delivered sales price minus outbound transport costs) are the main drivers for deciding where waste paper is sold to. Like any other commodity, waste paper is delivered to the best bidder. In some cases, specific waste paper grades can have limited outlets because only a few paper mills can use it in their paper making process.

Basically, there is no difference between domestic and exported waste paper quality. The demand of given qualities of waste paper strongly depend on the targeted quality of the paper mill's finished products, and the production techniques of the paper mill. Reprocessors and merchants are continuously looking for markets and good price opportunities. Other reasons for outlet management of waste paper are e.g. risk spread, logistic optimization, or exchange rates.

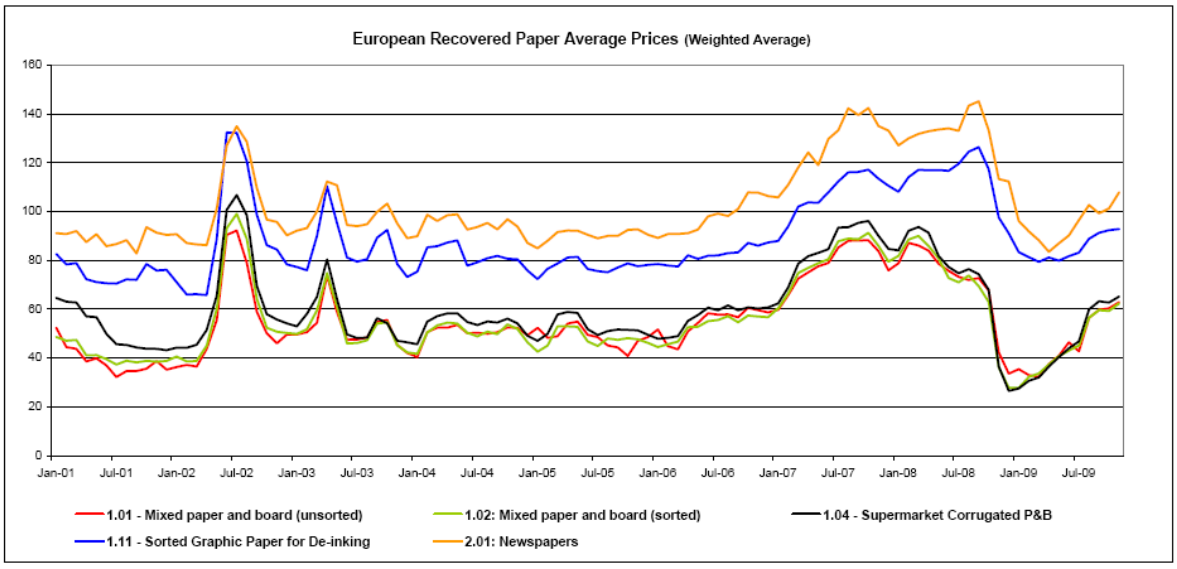
The price setting is usually based on the EN-643 standard grade. Should the actual traded material be different from the standard grade description, a different price might be applicable. Experts mention that the price-setting mechanism described is not expected to change significantly for waste paper that has ceased to be waste.

Waste paper markets are extremely volatile, and prices have ranged from 50 to 150 euros per tonne of the ordinary and middle grades in the last 10 years, with prices as high as 200 euros per tonne being recorded at peak demand periods (see Figure 10). Updated prices of most grades are widely available in most countries, and historical records of the 5-10 main traded grades are also available.

The supply markets for fibre from waste paper are, in economic terms, inelastic[32]. Demand and supply do not adjust quickly to price signals and to other changes in market conditions. This is a main reason for price volatility. Because much of the waste paper collection is part of political commitments and targets, particularly in Europe, supply will continue irrespective of the price of waste paper fibre (i.e., the European supply is relatively price inelastic). In case of a negative demand shock it is conceivable, although unlikely, that prices of low grade waste paper could fall to levels below the cost of collection and reprocessing, requiring intervention to ensure that the political commitments and/or recycling targets are achieved[33]. Demand is to a lesser degree inelastic, as paper manufacturing plants are large entities.

[32] WRAP, 2006

[33] WRAP, (2009) also notes that the United States plays an important market balancing role. Because fibre recovery in the US is almost entirely commercial – in comparison to Europe where it is at least partly statutory – the US collection of recovered fibre is more responsive to market conditions (i.e. US supply is more price elastic). Thus a fall in global RCF demand, and a drop in recovered fibre prices, would result in a greater contraction in US recovery than would likely to be the case in Europe. Consequently, Europe could expect to retain more of its export market, in tonnes, acquiring market share in weak markets from commercially-driven US suppliers.



Including:

1.01	Austria, Benelux, Czech Republic, Germany, Romania (from 2008), Spain, Switzerland and United Kingdom
1.02	Austria, Netherlands, Czech Republic, France, Germany, Italy, Romania (from 2008), Slovak Republic, Spain and Switzerland
1.04	Austria, Netherlands, Czech Republic, France, Germany, Italy, Norway, Romania (from 2008), Slovak Republic, Spain and Switzerland
1.11	Austria, Benelux, Finland, France, Germany, Italy, Norway, Spain and Switzerland
2.01	Austria, Benelux, Czech Republic, Finland, Germany, Italy, Norway, Slovak Republic, Spain, Switzerland and United Kingdom

Figure 10. Price evolution of some waste *(recovered [sic])* paper grades in CEPI countries, 2001-2009. Prices in EUR/tonne. SOURCE: CEPI, 2009.

According to BIR[34], collection and apparent consumption of waste paper are getting closer, and stocks of paper are becoming increasingly tight in the EU. This "real time" operation mode is apparently in conflict with the logistics of international container shipping, contributing to price instability and encouraging broker speculation. Such speculation is fed additionally by the opportunistic behaviour repeatedly observed in some large buyers with large stock capacity, e.g. in China, which instead of supporting long-term purchase contracts prefer to follow prices and buy large amounts for storage when prices plunge. This ensures them short term production at a low price, but once operations are completed reverts in price peaks and preserved volatility for the rest of the market.

On the other hand, volatility is a short-term effect that does not mask a background average prices of 45-150 EUR/tonne for the most traded grades, which together with a gradual increase the virgin and waste paper fibre demand internationally has slowly expanded the sector. This has been witnessed since the beginning of statistics collection, and following expert projections[35], the European paper industry's fibre demand is expected to grow from 96Mt in 2005 to 116 Mt in 2015-2020.

Another important element in the market assessment is the cost trend of the alternatives to waste paper recycling. With the development of stricter waste management legislation, often containing economic instruments, the access to alternatives at the bottom of the waste hierarchy are being made difficult through bans (e.g. on landfilling of biodegradable, recyclable and in some countries also combustible waste) or are penalised with gradually increasing taxes and fees. This scenario adjusts environmental externalities previously non-tackled and welcomes recycling of what is feasible to recycle.

In the presented market situation, one must not exclude that temporal global or local economy slowdowns result in prices of some grades being very low (20-30 EUR/t), just under the threshold of collection and processing costs, which would jeopardise the recycling system of these grades. Large waste paper generators (e.g. commercial areas) may be covered from breakdown by agreements of minimum price guarantee with reprocessors, and municipal waste paper collection is normally ensured by the administrations, which by legislation have the responsibility of providing the service. However, the

[34] Magnaghi, G. (2008), The world recovered paper market in 2007. BIR, Brussels, 2008
[35] COST E48, 2009

mentioned scenarios must be set in the perspective of the historical development of the market, in which these situations are recurrent but well spaced in time.

2.4. Standards and technical specifications

Standard EN-643 (CEN, 2001) in Table 5 below is as a central element in waste paper trade into and from Europe. It specifies a list of European standard grades of waste (*recovered* is the term used in EN-643) paper and board. Grades are numbered using a digit system, where the first number goes from 1 to 5, indicating the group:

- Group 1: Ordinary grades
- Group 2: Medium grades
- Group 3: High grades
- Group 4: Kraft grades
- Group 5: Special grades

Each group is composed of a number of subgrades, with 2 additional digits separated by a dot to define it. For example, for Group 1 there are grades from 1.01 to 1.11 (11 grades). For some of the grades, there are also further subgrades which are labelled by additional digits, for example, 4.01.01.

In this study and for simplicity, generally only 3-digit grades are mentioned, totalling 57 grades.

Grades are meant for use by waste paper buyers and sellers, and the list was created originally for use in the European market. The mere existence of the standard for waste paper grades is a form of indirect evidence of the existence of a market, since no consensus effort like the development of a standard would be made without a market.

The standard, however, does not define quantitatively the quality of these standard grades, but only gives a broad qualitative definition of what the grades shall and shall not contain. Accordingly, the standard indicates that the specific criteria for defining the percentages of usable and unusable materials for the grades will be subject to individual mills' specifications and be defined between producer and buyer.

The description of the standard grades is brief, and it is noted in the standard that specific deals between buyer and supplier for standard grades with special specifications will still be necessary to meet individual requirements.

Table 5. Classification of waste paper grades in the EN-643 Standard, as reproduced in CEPI and ERPA (2002)

Group 1 - Ordinary grades	Group 2 – Medium grades	Group 3 – High grades	Group 4: Kraft grades	Group 5: Special grades
1.01 Mixed paper and board, unsorted, but unusable materials removed • Various grades of paper and board; no restrictions on short fibre content; unusable materials removed (e.g. plastic envelopes)	**2.01 Newspapers** • Made up of read or unsold newspapers, containing no more than 5% mass-coloured material	3.01 Mixed lightly coloured printer shavings	4.01 New shavings of corrugated board	5.01 Mixed recovered paper and board
1.02 Mixed papers and boards (sorted) • As 1.01, a mixture of papers and boards; free of unusable materials, but with max. 40% old newspapers and magazines	**2.02 Unsold newspapers** • Includes unsold daily newspapers, free from additional inserts or illustrated material coloured in bulk	3.02 Mixed lightly coloured woodfree printer shavings	4.02 Used corrugated kraft 1	5.02 Mixed packaging
1.03 Grey board	2.03 Lightly printed white shavings	3.03 Woodfree binders	4.03 Used corrugated kraft 2	5.03 Liquid board packaging • Includes brick packaging and other multi-layer, multi-material packaging for liquids
1.04 Supermarket corrugated paper and board • At least 70% corrugated board; remainder: cartonboard and other packaging paper • Also known by its German name, "kaufhaus"	2.04 Heavily printed white shavings	3.04 Tear white shavings	4.04 Used kraft sacks	5.04 Wrapper kraft
1.05 Old corrugated containers • At least 80% corrugated board and other packaging papers • Commonly called OCC	2.05 Sorted office paper	**3.05 White woodfree letters** • Also known as white letters	4.05 Unused kraft sacks	5.05 Wet labels
1.06 Unsold magazines	2.06 Coloured letters	3.06 White business forms	4.06 Used kraft	5.06 Unprinted white wet-strength woodfree papers
1.07 Telephone books	2.07 White woodfree books	3.07 White woodfree computer print-out	4.07 New kraft	5.07 Printed white wet-strength woodfree papers
1.08 Mixed newspapers and magazines 1	**2.08 Coloured woodfree magazines** • Coated or uncoated magazines, white or coloured, but free from non-	3.08 Printed bleached sulphate board	4.08 New carrier kraft	

	flexible bindings, non-deinkable inks, glue and labels. It may include printed circulars, coloured shavings and up to 10% mechanical pulp-based papers. • Also known as "coloured best pams"			
1.09 Mixed newspapers and magazines 2	2.09 Carbonless copy paper	3.09 Lightly printed bleached sulphate board		
1.10 Mixed magazines and newspapers	2.10 Bleached woodfree PE-coated board	3.10 Multi printing		
1.11 Sorted graphic paper for deinking • Contains at least 40% old newspapers and magazines from household collections • Also known as "news and pams"	2.11 Other PE-coated board	3.11 White heavily printed multiply board		
	2.12 Mechanical pulp-based computer print-out	3.12 White lightly printed multiply board		
		3.13 White unprinted multiply board		
		3.14 White newsprint – Made up of shavings and sheets of white unprinted newsprint, free from magazine paper.		
		3.15 White mechanical pulp-based coated and uncoated paper		
		3.16 White woodfree coated paper, without glue		
		3.17 White shavings		
		3.18 White woodfree shavings – Shavings and sheets of white, unprinted woodfree paper, free from glue, but containing up to 5% coated paper • Also known as "white number two" **3.18.01 White uncoated woodfree shavings** • Same as 3.18, but should contain no coated paper • Also known as "best white number one"		
		3.19 Unprinted bleached sulphate board		

The 5 groups of grades of EN-643 belong to the following broad categories of waste paper[36]:

- Bulk grades: (mainly Group 1) Also known as brown, corrugated, low or ordinary qualities, are the grades of waste paper generated in largest amounts in Europe, covering ca. 50% of the flows, and stem from collection in commerce and households. The most common bulk grades are: 1.01, 1.02, 1.04, and 1.05 (marked bold in Table 5).
- Deinking qualities (mainly Group 2). Also known as gray, news, graphics, or middle qualities. The main deinking grades here are: 1.11, 2.01 and 2.08.
- Pulp substitutes (Group 3): Also called white or high qualities, are used in papermaking receipts together with virgin pulp to improve the quality of recycled printing products. The most widely found substitute grades are: 3.05, 3.14, 3.18, and 3.18.01.
- Group 4 grades, which are also high-quality paper (mostly non-deinked cardboard) types containing sulphate fibres (kraft).

Group 5 of 'special grades' was created to take into account developments in new paper products that were increasingly collected, for example from households requiring specific recycling processes. Their inclusion is justified by the existence of a significant European market. Actual recycling of Group 5 qualities can only be done by a limited number of mills with appropriate technology located in a few countries only.

The only clearly defined quality requirements in standard EN-643 are the following:

- Waste paper from refuse sorting stations is not suitable for use in the paper industry.
- Waste paper and board originating from multi-material (e.g. comingled) collection systems, containing only material of a valuable, recyclable nature is suitable but should be specifically marked, as it is not permissible to mix it unmarked with other waste paper and board.
- Waste paper and board will, in principle, be supplied with moisture of not more than the naturally occurring level (10%).When the moisture content is higher than 10% (of air dried weight), the additional weight in excess of 10% may be claimed back – with the method of testing and sampling to be agreed between buyer and seller.

The requirement on moisture not exceeding the naturally occurring level (10%) is to a large extent not a technical impediment, as waste paper will anyway be mixed with water in pulping, and is thus not detrimental to the papermaking process. The main argument for including it in the grade characterisation is of commercial nature: water in waste paper is a relatively dense material that paper mills do not reject but are not willing to pay for. In addition, too wet waste paper may be difficult to handle, as it would begin to crumble and fall apart. Moreover, if stored wet for long periods of time, and under the pressure of storage under a pile of other bales, it would create appropriate conditions for biodegradation, possible methane formation, and subsequent health and safety risks.

Special specifications can still be necessary to meet individual mill requirements, and are not excluded by use of EN-643. Expert from the technical working group confirm that to their knowledge, there are no currently traded waste paper types not included in the EN-643 grades, and there is no paper grade not included in EN-643 that could be candidate for EoW, except for mixes of EN-643 grades.

According to the WRAP report on "*International Trade in Recovered Paper and Plastics: International Regulations and Commercial Practice*" (WRAP, 2008), there are no internationally recognised standards (such as ISO) that have been widely adopted by reprocessors and paper manufacturers worldwide. British (BSI), European (EN), American (ISRI-PSI), and increasingly Chinese (AQSIQ) standards are widely referenced by operators when trading green list materials. It is understood by the reprocessors and paper manufacturers that because of the nature of the materials there will be a proportion of non-paper components. The extent to which these components are tolerated will depend on the sensitivity to them of the product and papermaking process, and the reprocessor's and papermaker's ability to remove them from the process. It is therefore the case that even when standards are used (e.g. EN-643), the actual composition

[36] BIR 2006

of waste paper from different sources will vary and this will result in different prices paid by different reprocessors and paper manufacturers for nominally the same material.

Update of EN-643

Despite all the work and compromise needed to achieve EN-643, it has become increasingly clear over the recent years that there are shortcomings in the current EN-643 standard. This is evident compared to other internationally used classifications such as ISRI's "Guidelines for Paper Stock"(USA), which defines the maximum allowed content of "outthrows"(unwanted material) and prohibitive materials by individual waste paper grade, and is frequently found easier to use than the EN-643 as a guideline in waste paper trade.

Some shortcomings reported are:
- the lack of defined tolerances for non-paper components, and paper or board outside the general grade description
- the range of grades is becoming insufficient
- a general perception that the standard is only for use within Europe.

The standard is perceived as a crucial element for commercial clarity, to the benefit of both buyers and sellers of waste paper. In a scenario of increasing world trade of waste paper, the reprocessing industry and papermaking industry understand that waste paper is not a perfect material, and can contain impurities – some of which are tolerable in small amounts, some are not, and it is important that these industry tolerances are better understood by regulatory authorities. Efforts are being made to promote the use of EN-643 outside Europe.

Some of the currently discussed revisions of EN-643 would include an update of:

- grade definition and description of grades (some of them are no longer relevant on the market, e.g. 3.06 "white woodfree computer printout" which with the IT development is no longer available). Additional subgrades in order to further clarify the slight variations in quality and price within the grades categories.
- assessment and improvement of the international practicability of the grade list;
- better definition of unusable materials, and re-evaluation of tolerance levels for unusable material for paper manufacturing, without the need for further sorting or processing prior to pulping.

The first meetings for this purpose have already taken place between ERPA (European Recovered Paper Association), FEAD and CEPI, but the formal work has not yet started.

It is expected that the new standard will define tolerance levels of non-paper components per grade. Most tolerances will likely be in the range between 0.25% and 1.5%. This is very similar to the outthrow tolerances found in ISRI grades, which for most grades are between 0% and 1%, with only two grades exceed this, namely "(#36) - Unsorted Office paper" (2%), and "(#1) Residential Mixed Paper" (2%)[37].

Waste paper baling conditions

CEPI has published additional best-practices guidelines on baling[38]. The recommendations are made so that bales can be handled, transported and stored safely and cost efficiently: bales should be right-angled and well pressed; parallel wires should be encouraged; a bale identification system is also suggested. The minimum length of the bales in the guideline ensures that the bales do not slide during transport. The following are minimum proposed requirements for baling:

Table 6. Minimum requirements for baling (CEPI, 2009). NOTE: the maximum legally allowed truck load may be different out of the EU

[37] ISRI (2009) Guidelines for Paper Stock: PS-2009-Export Transactions.
[38] CEPI, 2005. "*Best Practices: Recovered Paper Baling Conditions*", http://www.paperrecovery.org/files/BalingConditions-154707A.pdf

Minimum weight of a bale: 400 kg
1st category: "Medium Bales" Dimensions of the bales: Length: Between 1m and 1.50m Height and Width: Between 0.75m and 1.25m Weight: From 400 kg to 800 kg
2nd category: "Big Bales" Dimensions of the bales: Length: Between 1m and 2.50m Height and Width: Between 0.75m and 1.25m Weight: From 700 kg and more
The minimum optimum weight to be loaded on each truck should be the maximum legally permitted, i.e. 23,500 kg

Control of quality

The industries involved in the paper cycle carry out many quality control checks of waste paper throughout collection, sorting, storage, grading, transport and admittance to papermills. Most of these controls are visual, and do not involve quantitative measurements. Currently, the quantitative controls mainly take place at papermills and focus on measurements of four parameters:

1) Moisture content (as % dry air weight)
2) Unusable non-paper components (as % dry air weight)
3) Unusable paper material (as % dry air weight)
4) Total weight of the consignment (as wet weight)

Paper mills may ask for a declaration from the supplier about the origin of the material, in relation to national regulations, standard requirements, or directly on the composition of the waste paper transported. Knowledge of the origin of waste paper is in general useful for risk management at papermills and of particular concern for some papermills that manufacture products meant to be in contact with food.

To complement the EN-643 standard, CEPI and ERPA have issued waste paper quality control guidelines (CEPI, 2004). Amongst other things, these guidelines recommend that:

- Quality controllers should be independent from the commercial department.
- A description of the waste paper quality control procedures and system installed and operating at the waste paper plants – currently in the majority of cases only visual control and weight measurement – should be given by the supplier to the buyer before the first contract is signed between them.
- Quality controls (weight and visual controls) should progressively move and be made at the waste paper processors.
- One delivery document has to be established by the last supplier per consignment and a copy has to be given to the paper mill.
- The delivery document must at a minimum include the identification of the contract partner, the identification of the trailer, the delivered grade according to EN-643, the weight, the number of bales or bulk.

- Paper mills may ask for a declaration from the supplier about the origin of the material in relation to the EN-643 standard.
- Results of the quality controls made at the paper mills and at the waste paper plants can be available on a reciprocity basis.
- Controls at the sorting plants: visual controls and use of a calibrated weighbridge should be considered as a minimum.
- Controls at the paper mills: moisture content, non-paper components (metal, plastic, glass, textiles, wood, sand and building materials, synthetic materials, 'synthetic papers'), and paper and board detrimental to production.
- Information on the results of the quality controls should be given by the buyers to the suppliers through periodical reports (in case of rejects, the results of the controls have to be given immediately).
- Conditions for reject and re-classification should be clearly established (precision has to be given regarding the threshold and the requirements).
- The conditions and the limits of the ownership of the waste paper and the responsibility for the materials delivered should be clearly established between the supplier and the buyer.

Sampling can be carried out manually or using specialised devices, and vary depending on whether the consignment is loose or baled.

Quantitative (gravimetric) manual sampling of bales consist of the random selection of one or two bales of the consignment. The bale(s) is open by de-wiring and a sample of 30 to 100 kg is taken. The sample is manually sorted in various components (paper types, plastic, wood, glass, etc.). Each category of components is dried and weighted to quantify the amount of non-paper components, unusable paper, and to be measured per air dry weight. Moisture content is also measured by sampling, weighting, drying and weighting again.

For the loose consignments, one of several possible procedures consists in spreading the load on the floor and sampling on a 2 meter length on all the width of delivery, followed by the manual sorting of components and moisture content measurement. When waste newsprint is used as raw material in a process requiring de-inking, the age of the newsprint has to be assessed by reading the date, because of difficulties to deink old newspapers, as the ink properties change and it binds strongly to the fibre.

Sampling devices are normally based on core-drilling. These devoices are used to extract samples from bales. Samples ca be of 20-100 grams. Moisture content measurement can be automatised through sensors, but non-paper components and unusable paper content are often still undertaken manually by gravimetry. Several core-drilling systems are available on the market. Sensors are evolving to also enable material distinction (image analysis, near infra-red technique and mass spectrometry). The Near Infra-Red (NIR) spectrometry has been already used since many years in other sectors such as food processing in order to study precisely and quickly sample’s chemical composition. Using these sensor technologies, several instant measurements are possible. Some sensors under development may allow automatised determination of grade following EN-643.

The simplest gravimetric procedures do no require advanced equipment, and can be undertaken with simple devices such as a sorting table, a scale and a microwave. Conversely, the design of a sampling plan that fits the quality of the waste paper requires advanced knowledge of quality control and of statistics.
Nevertheless, a statistically sound sampling plan reduces to the minimum the frequency of sampling required.

In addition to the mentioned quality control guidelines, CEPI has issued a "Guideline for paper mills for the control of the content of unusable materials in recovered paper" that sets the overall quality control of content framework, INGEDE has published methods for visual inspection of loose and baled material (methods 7&8) and for gravimetric determination of composition (method 14), and reprocessors have also recently proposed a "Quality Control Procedure" (REPACAR and ERPA, 2010), that describes in guideline terms the minimum procedures recommended to use by reprocessors of waste paper, at two stages:

1) Inspection upon receipt. Waste paper arrives at the facilities in different transport means and sizes: by trailer (waste paper packaged), in containers, in auto-compressors, in compressors, in trucks, etc. This

depends on the origin as separate collection, from households, bins, companies, shopping centres, or from other reprocessors. Once the consignment has arrived, it is weighed on a calibrated scale, and the weight is recorded. This is followed by visual inspection, and for baled input may involve opening randomly a number of bales. Depending on the quality, waste paper is unloaded at the relevant warehouse location, and if not meeting the contracted quality, the supplier may be contacted to renegotiate the price of the consignment, and in some cases the consignment may be rejected. Accepted waste paper may then be sorted, shredded, graded and baled.

2) Inspection prior dispatch. Once graded, waste paper can be baled and/or shredded. Internal procedures may exist to ensure proper baling, should this be necessary.

The guideline emphasises the need that experienced staff trains novel staff into the criteria used for visual inspection. Training is also emphasised in CPIs *Export Code of Practice*, which enumerates the following key requirements for the training of staff performing visual inspection:

A sound knowledge of:
• Company reporting structure;
• recovered paper grades and associated standards;
• what non paper components are;
• what contamination is;
• what to do within the process to remove and limit the above;
• what to do with non paper components removed from the process stream;
• the health and safety requirements of the process;
• what to do with non conforming bales of recovered paper;
• the documentation requirements for processed material; and
• regulatory requirements for recovered paper movements.

Due to the fact that quantitative content control is so far made by papermills to the incoming material, each papermill has designed their sampling plans to fit their needs. No guideline has been developed so far for the reprocessors to control quantitatively the output, including e.g. a simple spreadsheet tool based on sound statistics. In a scenario where some waste paper streams cease to be waste, such tools could help reprocessors define a sampling plan as part of their quality management, and take better control over their output. The reprocessors of other recyclables such as glass are very familiar with these procedures, as quality control of output is commonplace in reprocessing of waste glass.

Input materials and communication

Normally, results of paper mill controls are communicated back to the reprocessors for checking with their own controls. All EU paper mills currently ask for a waste paper by grade. The grade of the materials is mandatory because it defines price and quality. In addition, some mills e.g. food packaging producers have to care about food contact with their product and demand an “origin” declaration. In such cases, apart from the EN-643 grade, some special quality requirements may apply. The origin is known for most grades, and as a general rule, pre-consumer waste paper is cleaner than post-consumer waste paper, and it needs less sorting. Other than food contact paper products, the origin of the material is secondary to the output quality after processing and grading.

2.5. Legislative aspects

In order to clarify the legal basis for trade of waste paper, it is necessary to analyse both the legislation currently controlling waste paper as waste, and the legislation that would cover waste paper if it no longer was waste. The question to be answered is: how would product legislation regulate and control the environmental risks associated with waste paper disposal/recovery once it ceases to be waste?

In the EU the management and trade of waste paper are currently under waste regulation, respectively the Waste Framework Directive and the EU Waste Shipment Regulation. Waste paper reprocessors operate under a permit for waste treatment, although the details of their permits vary among Member States.

The production of paper at paper mills and the associated treatment of waste paper on site are subject to the IPPC Directive. The current discussion on the possible extension of the scope of the IPPC Directive in relation to waste treatment activities has suggested the inclusion of separate installations for paper treatment.

Packaging paper is also regulated under the "Packaging Directive" (Packaging and Packaging Waste Directive, 94/62/EC[39] of 20 December 1994, amended by 2004/12/EC). This Directive is intended to harmonize national legislations with the goal of preventing or reducing the environmental impact of packaging and packaging waste. Its provisions address the prevention of packaging waste, the reuse of packaging materials, and their recovery and recycling. As part of the Directive's provisions, the following commitments and targets for packaging waste recycling are set (longer deadlines apply to the new Member States):

Article 6.1 (e) no later than 31 December 2008 the following minimum recycling targets for materials contained in packaging waste will be attained:
[…]
(ii) 60 % by weight for paper and board;

By 2007, new targets shall have been set for the next 5 year period (2009-2014). However, in a Report of December 2006 (COM(2006) 767 final), on the implementation of Directive 94/62/EC on packaging and packaging waste, the Commission announced that the recycling and recovery targets contained on the Packaging Directive are currently optimal and proposed these should remain stable to enable all the Member States to catch-up with these targets.

Estimates from CEPI indicate that in 2008, about 80% of paper-based packaging was recycled, obviously with differences among Member States.

In addition to the product specific target set by the Packaging Directive (94/62/EC), an overall 2020 target of minimum 50% re-use or recycling rate for at least paper, metal, plastic and glass collected *from households (or similar) sources is set in the Article 11(a) of the Waste Directive (2008/98/EC):*
"by 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 50 % by weight."
This target is not to be met by each material individually, and CEPI[40] expects that paper recycling of at least current level (66.6% in 2008) will be required to reach and exceed the overall target of 50% by 2020 while some other materials from households will not be able to get close to the average of 50%.

The following legislation is discussed below:

- Waste shipment regulation
- REACH
- By-product definition under the WFD
- Other trade regulation issues (China)
- VAT

Waste shipment regulation - WSR

Exports for disposal are, apart from some very restricted exception, prohibited. Under the Waste Shipments Regulation (WSR) [41], wastes can be shipped for recovery, and are divided into two different control

[39] European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, amended by 2004/12/EC http://europa.eu/legislation_summaries/environment/waste_management/l21207_en.htm

[40] Pers. comm.. CEPI (2010)
[41] Regulation (EC) No. 1013/2006 of the European Parliament and the Council of 14 June 2006 on shipments of waste (Waste Shipment Regulation), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32006R1013:EN:NOT

categories known as the green and amber lists. The WSR will remain the alternative framework for the transboundary movement of waste paper not meeting the EoW criteria and thus not falling under EoW provisions.

Broadly speaking, wastes on the green lists are non-hazardous, and are subject to minimal controls when shipped between EU Member States for recovery. Wastes on the amber lists are deemed to be hazardous and are therefore subject to more stringent control regimes within the EU. Waste paper, in an uncontaminated, homogenous form with minimal non paper components, can be shipped under green list controls as it is non hazardous. For hazardous waste, its transboundary movement is regulated by the Basel Convention[42]

If waste is exported to be recovered, the WSR controls ('green list' controls or notification controls) applying will depend on the type of waste shipped and the country where the recovery is to take place, as belonging to one of these groups:

• an EU Member State – except for the 'new' Member States listed below;
• a 'new' EU Member State, namely Latvia, Poland, Slovakia, Bulgaria or Romania;
• an OECD Member State;
• a non-EU Member State outside the OECD.

Where waste is to be shipped from an EU country to a non-EU country, additional controls apply. It is generally not prohibited to export waste paper or other paper-containing waste from a EU Member State to recovery in a third country outside the EU. If the non-EU country is a Member of the Organisation for Economic Co-operation and Development (OECD), the controls are similar to those within the EU. However, if the non-EU country of import is not a Member of the OECD, then following an amendment made to the Basel Convention in 1995, exports of amber (i.e. hazardous) wastes, even for recovery, are banned completely.

For "green list" exports (recycling) to non-OECD countries, the Regulation requires the Commission to obtain a new declaration from the receiving country as to whether it will accept each kind of waste; it may also require pre-notification and consent. The country of import can choose which green list wastes it wishes to import for recovery, and which it does not.

Most of the responding countries have waste paper as green list without the need of control, including, from the top-10 importers (see Fig 9), Philippines, Thailand and India. Waste paper is not prohibited by any of the top-10 world importers, but all of them require either prior written notification, or have own additional control procedures (see dedicated section below). However, some of the non-OECD countries failed to respond and where no reply is received, those countries are to be regarded as having chosen a procedure of prior written notification and consent. Default controls of prior written notification and consent are applied, which requires administration and payment of a fee as well as the establishment of a financial guarantee, and shipments are delayed whilst this is completed

In consequence, it is important that those wishing to export waste paper for recycling outside of the EU are not only sure that their material properly falls under the green list categorisation, but also check that the importing country is prepared to accept the material without further controls.

In any case, the Waste Shipment Regulation allows exports from the Community only if the facility that receives the waste (i.e. paper mill or other) is operated in accordance with human health and environmental standards that are broadly equivalent to standards established in Community legislation (IPPC). In reprocessing and recycled paper manufacturing, waste paper must be dealt with in an environmentally sound manner, without causing health risks. Generally, the reprocessor should be licensed or permitted in some way by the relevant local regulatory authorities.

[42] The Basel Convention, http://europa.eu/legislation_summaries/environment/waste_management/l28043_en.htm

Waste paper under green list controls may contain the following materials[43] (WSR Annex V 1B: B3020 Paper, paperboard and paper product wastes):

"provided they are not mixed with hazardous wastes:
Waste and scrap of paper or paperboard of:
— unbleached paper or paperboard or of corrugated paper or paperboard
— other paper or paperboard, made mainly of bleached chemical pulp, not coloured in the mass
— paper or paperboard made mainly of mechanical pulp (for example, newspapers, journals and similar printed matter)
— other, including but not limited to
1. laminated paperboard;
2. unsorted scrap"

"Green list' controls include:

- The waste can be moved legally without obtaining permission from the regulators.
- The waste must be accompanied by a completed and signed "Annex VII form".
- Specified contracts for recovering the waste between the person sending the waste and the person receiving the waste must be in place.
- When the person receives the waste, he/she must sign the accompanying form.
- Copies of the form relating to the waste movement must be kept for three years.
- The regulatory authorities can ask for copies of the documents relating to the movements already made or ask for information from those documents.

According to the comments received by some experts of the technical working group, some of the entries of the regulation, as quoted above, are non-exhaustive (e.g. expressions like 'including but not limited to'), and this ambiguity opens the possibility of different interpretations by the enforcement authorities.

The OECD (2009) reports that traders encounter problems related to the "Annex VII form" requirements. The traders mention that the form adds administrative burden, which they do not feel is necessary, but the main concern is about providing information on the origin and the final destination of the shipment, which in some cases is perceived as confidential for commercial reasons. This confidentiality is no longer guaranteed if the buyer and seller of the traded paper get this information via the Annex VII form. End-of-waste will impact trade, as paper that fulfils EoW criteria will not be under the waste shipment regime.

The procedures laid out in OECD Decision C(2001)107/Final concerning the control of transboundary movements of waste destined for recovery indicate that the materials may be traded for recovery using normal commercial controls within the OECD. This implies that the standard customs controls for goods are applied to these materials, without additional procedures. According to (OECD 2009: Joint Working Party on Trade and Environment: Reducing barriers to international trade in non-hazardous recyclable materials: exploring the environmental and economic benefits, Part 1: A synthesis report), the US and Japan apply the OECD Decision in this way. Conversely, the EU follows the WSR and applies the 'green list controls' to waste paper.

The logics of end-of-waste is that waste paper that has fulfilled the criteria and has become product is no longer under the waste shipment regime. As the scope of application of an end-of-waste regulation is the EU, nothing can be said on how a stream is classified (waste/ non-waste) at a destination out of the EU. The adoption of the EoW criteria may or not influence the criteria currently used for such decisions out of the EU, e.g. acknowledging at destination non-waste status for consignments classified as such before leaving the EU.

REACH

REACH is a European Community Regulation on chemicals and their safe use (EC 1907/2006) [44]. It deals with the Registration, Evaluation, Authorisation and Restriction of Chemical substances. The Regulation

[43] List of wastes from Annex V of 1013/2006 (Annex IX to the Basel Convention, reproduced in Annex V, Part 1, List B, of 1013/2006)

entered into force on 1 June 2007. The aim of REACH is to ensure a high level of protection of human health and the environment, pomote alternative methods for assessment of hazards of substances, and facilitate the free circulation of substances on the internal market.

When waste paper ceases to be waste, it becomes subject to the provisions of REACH. The implications of this are discussed in detail in Chapter 4.

By-products

If a certain waste paper generated, for example by a printing industry, were regarded as being a by-product, and not being waste, in the sense of Article 5 of the WFD, then a possible interpretation is that end-of-waste criteria would not apply to it, unless the by-product becomes waste at a later phase. By-product status should not be an alternative to avoid compliance with end-of-waste, but this is not likely to be the case, as by-product conditions are even more strict than end-of-waste, e.g. Art. 5 (b) and Art. 5 (c) below, both of which are not required for end-of-waste and would only be met by some high quality flows of pre-consumer waste paper.

Article 5 of the WFD on by-product reads as follows:

"1. A substance or object, resulting from a production process, the primary aim of which is not the production of that item, may be regarded as not being waste referred to in point (1) of Article 3 but as being a by product only if the following conditions are met:

(a) further use of the substance or object is certain;

(b) the substance or object can be used directly without any further processing other than normal industrial practice;

(c) the substance or object is produced as an integral part of a production process; and

(d) further use is lawful, i.e. the substance or object fulfils all relevant product, environmental and health protection requirements for the specific use and will not lead to overall adverse environmental or human health impacts.

2. On the basis of the conditions laid down in paragraph 1, measures may be adopted to determine the criteria to be met for specific substances or objects to be regarded as a by-product and not as waste referred to in point (1) of Article 3. Those measures, designed to amend non-essential elements of this Directive by supplementing it, shall be adopted in accordance with the regulatory procedure with scrutiny referred to in Article 39(2)."

It is noticeable that Article 5 of the WFD says "…*may* be regarded…", which leaves a certain freedom of choice even if the four conditions of Article 5 are met, as long as measures under Article 5.2 have not been adopted.

Other regulatory elements in trade

The UK's Confederation of Paper Industries 'Export code of practice'[45] allows a maximum of 2% by weight of non-paper components. Within this 2%, a maximum of 0.5% for some materials (metal cans, plastic bottles, film or non-bottle plastic packaging, glass containers), 0.1% for others (textiles, rope/string, wood, non-container glass, sand/building materials) and 0% for materials listed in the annexes IV and IV-A

[44] REACH, http://ec.europa.eu/environment/chemicals/reach/reach_intro.htm

[45] Confederation of Paper Industries (CPI) "Export Code of Practice", http://www.paper.org.uk/current_issues/exports/exportCodeofPractice030407.pdf

of the Waste Shipment Regulation[46] (EC No. 1013/2006). Prohibited materials are any materials which, by their presence in a packing of paper stock in excess of the amounts allowed, make the packing unusable as the grade specified, or which pose a risk of damage to the equipment.

Regulatory authorities may assess exported waste to test whether or not the exporter has appropriately classified the waste. In some cases there may be differences in approach between regulators inside the EU for shipments outside the EU. For example, an official from the Dutch regulators might intercept a consignment on route from the UK to China and conclude the waste being exported should be considered differently from what the exporter declared. In such a case the view of the Dutch authorities would prevail and the exporter would have to pay to have the waste repatriated to the UK, even if the UK regulatory authorities were satisfied with the waste category declared by the exporter.

Trade with China, India and Indonesia

According to WRAP[47], the Chinese national provisions require that a waste shipment be accompanied by three documents and these documents must be arranged prior to shipment in order to be considered legal and be allowed for import by the Chinese government. The procedure of exporting waste paper to mainland China involves:

- Ensuring that the receiving facilities (destination) have the Chinese SEPA-licence; this includes conformity with the Environmental Protection Control Standard for Imported Solid Wastes as raw materials.
- Obtaining a so-called AQSIQ licence
- Obtaining a pre-shipment inspection certificate from CCiC[48]

Chinese importing restrictions for waste paper include additionally:

- The amount of hazardous components (e.g. asbestos waste, burnt or partly burnt waste paper, etc.) not to exceed 0.01%.
- The amount of non-hazardous components (such as wood, waste metal, etc.) not to exceed 1.5% of the weight of the imported waste paper.

In the case of India and Indonesia, BIR[49] reports that these two countries are planning to implement stricter quality controls on imported paper fibre. Indonesia has issued a decree in December 2008 requiring all paper fibre shipments to be pre-inspected by third parties (e.g. SGS, Bureau Veritas) to ensure the shipment is not waste. India is also introducing requirements on inspection certificates for imports, confirming the absence in the shipment of municipal waste, biomedical waste and hazardous waste, plus a chemical certificate.

According to some experts of the technical working group, WSR and Asian inspections increase bureaucracy and cost of shipments, however regular changes in the Asian import requirements do hinder recycling, as changes in legislation are usually announced in the national language without prior notice. In such cases, the consequences of the legislative changes are not clear to the exporters, and often to the custom and inspection staff. According to the latest communications in relation to the WSR, other Asian countries or regions applying controls based on national law are Taiwan and Vietnam.

VAT

Member States have the authority of deciding whether waste paper that has ceased to be waste is subject to value-added taxation.

[46] Regulation (EC) No. 1013/2006 of the European Parliament and the Council of 14 June 2006 on shipments of waste (Waste Shipment Regulation), http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32006R1013:EN:NOT

[47] WRAP, 2008

[48] China Certification & Inspection (Group) Co., Ltd (CCIC) is a transnational company and dedicated to provide "inspection, surveying, certification, and testing" services. CCIC is the first nationwide non-governmental organization in China, focusing its principal activities in the field of import & export commodity inspection, survey, and certification.

[49] BIR (2009) BIR world mirror – recovered paper Quarterly report, April 2009 and July 2009. BIR, Belgium

The Commission is responsible for ensuring the correct application of Community law, which in this case is the VAT Directive. However, since this Community legislation is based on a Directive, each Member State is responsible for the transposition of these provisions into national legislation and their correct application within its territory. Therefore, the details about the taxation of waste paper in a specific Member State are based on the national tax administration.

2.6. Environmental and health issues

For the purpose of determination of EoW criteria, the interest as regards environment and health is to ensure the fulfillment of condition (d) of Art. 6 in the WFD, that is, that by changing the condition of paper from waste to non-waste, *'the use of the substance or object will not lead to overall adverse environmental or human health impacts'*. The question is therefore to analyse which are the direct and indirect environmental impacts related to paper collection and recycling.

Potential impacts of paper collection and recycling

Paper bales of most grades of waste paper do not normally leach, since their main components are not soluble in water (ink, paper fibres) or soluble but of no impact (limestone, china clay, both naturally occurring). An exception to this may be carbonless copy paper[50]. In contact with water, paper bales get wet on their surface, but it is very difficult that water penetrates inside a paper bale, or a loose material pile, as this requires very prolonged exposure. Moisture content is one of the parameters always controlled in waste paper trade, and if moisture content trespasses a given threshold (normally around 10-12%) this reduces the value and price of waste paper. Dry waste paper has under normal indoor storage conditions a 5-10% moisture content.

Only if deliberately watered or accidentally submerged or in prolonged contact with water can the 10-15% moisture content trespassed. However, if such consignments are received at a paper mill, the material is swiftly moved to the pulper. This is because if stored wet for long periods of time (weeks), and under the pressure of storage, appropriate conditions for biodegradation and mould formation are created, methane can be formed, and subsequent nuances (odours), health and safety risks (fire) can be caused. According to FEAD (2010), mould formation takes only place above 45% moisture, a content which does not meet EN463 recommendations and is only exceptionally seen in industrial practice.

There is therefore no interest for the supplier (transporting water for which it will not get paid) or the buyer (receiving an inconvenient quality material) in allowing waste paper getting too wet.

It is common that small pieces of paper and dust blow around in open-air paper yards exposed to the wind. This can be solved by the covering of reprocessing plants to protect the waste paper bales or piles. Regarding transport, the companies in charge of transport need to have a permit for waste transport and appropriate transport means. Under normal operation and cleaning practice of trucks, there should be no cross-contamination to a waste paper load transported after other waste.

At the mills, odours, noise, dust and other environmental aspects are covered by IPPC permits under the IPPC Directive. Reprocessors do not follow normally IPPC legislation, and operate under permits that include in general the exploitation conditions, but do not normally specify emission limits or types and methods of control.

Paper recycling: energy, emissions and resource use issues

[50] Carbonless copy paper consists of sheets of paper that are coated with micro-encapsulated dye or ink and/or a reactive clay. The back of the first sheet is coated with micro-encapsulated dye. The lowermost sheet is coated on the top surface with a clay that quickly reacts with the dye to form a permanent mark. Any intermediate sheets are coated with clay on top and dye on the bottom. Formerly, PCBs were part of the dyes –now phased out-, and currently are based on complex chemical mixtures, some of which may cause contact dermatitis in sensitive persons or have been found to be endocrine disruptors (Bisphenol A). Carbonless copy paper is normally part of the unusable papers.

It is well known from LCA studies that recycling of most waste paper types contributes to an overall energy and air emission saving compared to the use of virgin pulp, quoted savings ranging between 20 and 60%[51]. Furthermore, through closed loop recycling the extraction and processing of other natural resources in paper are also saved, including water, chalk, carbonates and titanium dioxide, and some air (74% less sulphur dioxide) and water (35% less chlorine) emissions are avoided.

These resource savings are the very essence and driver of recycling of paper. Together with the total monetary costs of collecting and processing waste paper, they match the cost equation that keeps the recycling system running. The direct savings are thus a necessary, though not sufficient condition for proving the existence of a market, as the information is only complete when the total costs are incorporated, including the economic effects of legislation (subsidies, taxes, etc.), environmental protection (pollution abatement, disposal of rejects, etc), and investments in technology.

Recycling avoids the disposal of used paper, and this still takes place via landfilling in a large number of EU countries, resulting in methane emissions by anaerobic biodegradation. While energy recovery of waste paper through incineration is also an option to avoid landfilling, in most paper types and energy supply conditions the aggregated (life-cycle) energy savings of this option are not as high as those of recycling (see e.g. IPTS, 2008).

Exceptions exist where incineration can be a favourable option, e.g. paper types of low recyclability because of high content of non-paper components (adhesives, plastics, metals, glass, cross-contamination with food, solvents or oil), inadequate size fibres (paper from destruction of confidential material), inadequate fibre type (money paper, dyed fibres). Recycling processes which use exclusively solid fuels and have old, energy-intensive technologies can also be worse performers in environmental terms than energy recovery options.

Risk of inappropriate management of overseas end-of-waste shipments

Should a paper EoW consignment be used in the EU, it shall go for recycling, and it can be controlled that the pulper reject that collects all the non-paper components is treated according to EU waste law. Should a paper EoW consignment be exported out of the EU, two uncertainties arise:

(1) Whether it will be recycled. The only known fact is that by meeting the EoW criteria, it has sufficient quality, a value, and a market.

(2) If once recycled, the rejects will be treated appropriately, be it recovery or disposal. Should the consignment remain waste, recital 33 and Art.48(2) of the Waste Shipment Regulation requires management conditions at the destination that are broadly equivalent to those in the EU[52]. If the consignment is EoW, this can not be requested.

Some waste paper types, such as coated and layered paper, can contain between 5 and 25% of non-paper material in the form of layers of plastic/metal. Well-known examples of these are beverage cartons (e.g. tetra-bricks), containing 25% plastic and aluminium, and PE-coated kraft sacks. Out of 60 million tones of waste paper collected for recycling, only less than 1% is layered. The remaining 99% of waste paper types have only <0.5% of other materials than paper, e.g. spirals, staples, glue for binding, or windows in envelopes. Examples of paper layered with non-paper materials are summarised in Table 7 below, including grades where these paper types are characteristically present.

Table 7. Examples of non-paper layered paper.

Waste paper type	Content of non-paper material	Grade according to the standard EN643
board coated with PE	~ 5% PE	2.10 and 2.11
polycoated sacks	~ 5% PE	4.04.01 and 4.05.01

[51] IPTS, 2009; Merrild et al., 2009,BIR 2009, Villanueva et al. 2007, WRAP, 2006, Aylesford 2008

[52] *'The facility which receives the waste should be operated in accordance with human health and environmental protection standards that are broadly equivalent to those established in Community legislation.'EC/1013/2006*

liquid board packaging (also called beverage cartons)	20%PE, 5% aluminium	5.03
mixed packaging, can contain liquid board packaging	anything from 0.5 to 25%, depending on the liquid board packaging content	5.02

Because of the larger content of inherent non-paper components, layered paper results in a larger generation of rejects per kg. of material. It has therefore a higher inherent potential for impacts out of the EU in case it is improperly disposed of (i.e. it is not recycled), or in case its rejects are improperly disposed of. Seen from a wider perspective, the total amounts of rejects from layered paper are very small compared to the total rejects generated from the remaining 99% of exported non-layered paper, but the inherent risk (i.e. per kg of material) is much larger.

This content of non-paper material is considered inherent, i.e. part of the paper products. It is bound to the paper, and once these paper products become waste, it can not be separated using dry sorting techniques such as hand-picking or mechanical screening. It can only be separated, often with previous shredding, in the pulper of a paper mill, i.e., in a wet phase that dissolves the paper fibres in water and is able to remove the rest of materials in a reject.

The potential impact of EoW of the shipment of layered materials will depend on whether these materials are excluded or included in the present EoW proposal. A discussion from a wider perspective that includes also economic and strategic arguments is included in the next section.

3. End-of-waste criteria

End-of-waste criteria for a material should be such that the recycled material has waste status if – and only if – regulatory controls under waste legislation are needed to protect the environment and human health.

Criteria have to be developed in compliance with the legal conditions, be operational, not lead to new disproportionate burdens and undesirable side-effects, and consider that waste paper collection and recycling is a well-functioning industrial practice today. Criteria have to be ambitious in providing benefits to as many waste paper flows as possible, but must also address with priority the main and largest represented flows in the EU. Criteria cannot fail to target these priority flows by trying to encompass all existing waste paper flows, and all national and regional singularities.

It has been reported that the current waste status of waste paper (and other recyclable waste materials) creates in some cases a variety of administrative and economic burdens, especially related to storage, shipment and transport, and creates legal uncertainty by keeping under waste legislation a material that in practice is perceived and treated as a product.

The following main benefits can be expected when EU-wide end-of-waste criteria for waste paper are introduced:

- Clearer differentiation of the high-quality waste paper, and recognisable distinction to lower-quality waste paper. Certainty that only high-quality waste paper will cease to be waste. This confirms additionally the waste status for low-quality waste paper, and the reasons for keeping it;
- Improved functioning of the internal and external markets to the EU (simplified and harmonised rules across countries, increased legal certainty, increased transparency and reliability on quality assured shipments);
- Reduction of administrative burdens related to shipment, transport and trade that are redundant for environmentally safe materials.

EoW criteria have to be clear, concise and enforceable. They have to be robust and controllable through spot checks, and minimise non-compliance that may undermine the credibility of end-of-waste criteria.

The definition of the criteria has been guided by the principles of simplicity and proportionality. Criteria have been proposed in the less intrusive form possible, yet ensuring fulfilment of the conditions of Art.6 of the WFD. Proportionality has been used in the prioritisation of the target waste paper groups, addressing first the largest flows. In the appraisal of the need to set a criterion, criteria are introduced only where it is judged that the magnitude of the risks of unintended consequences or of impact to health and the environment requires it.

Following the findings of the JRC methodology guidelines for EoW[53], the ultimate aim of end-of-waste criteria is product quality. End-of-waste criteria include direct product quality requirements. In addition, a set of end-of-waste criteria may include other elements that help indirectly to ensure product quality, in particular requirements on input material, requirements on processes and techniques, and on quality assurance procedures. The criteria are a package, linked to each other. This means that e.g. stricter quality criteria may make redundant the inclusion of one or more of the input or process criteria.

Following these considerations, it can be summarised that waste paper should cease to be waste when:

- Waste paper complies with industry specifications for a waste paper grade for which there is a market and demand by the paper producing industry;
- Waste paper includes precise information about the type(s) of paper(s) contained, and has a known maximum content of non-paper components. Other properties of interest to the buyer such as unusable paper and moisture may be added as non-compulsory information;

[53] Can be downloaded from: http://susproc.jrc.ec.europa.eu/activities/waste/

- Waste paper has not hazardous properties;
- Waste paper is during processing not in contact with certain waste types that can cause cross-contamination, e.g. biowaste, oil waste, waste solvents, health care waste or mixed municipal solid waste;
- The producer of waste paper provides documentation of the fulfilment of all conditions above, and supplementary information concerning the limitation of use to paper manufacturing.

Furthermore, the end-of-waste criteria for waste paper should not disrupt the existing recycling systems. They should simply identify where waste paper has attained a quality that is sufficient to ensure that no environmental risks occur when it is transported, further processed or traded without being controlled as waste. For ensuring no disruption of existing, well-functioning systems under waste law, the end of waste is proposed and is to be understood as an option for high quality material, in no case an imposition. The main players in these systems (collectors companies, administration) can opt for modifying the existing recycling systems or parts of these systems under their control, in case they see larger benefits in the new status than keeping the waste status.

In the specific case of waste paper, the additional requirement on the provision of information is necessary to limit the scope to the manufacture of paper, and document awareness and acceptance of the producer to this intended use. Different options are possible for achieving this, including provision of a contract with a paper mill, or signature to a traceability system, and compulsory labelling. The options evaluated are presented and discussed further in the section on provision of information.

This approach to define a set of end-of-waste criteria combining several levers of action corresponds well to current good industrial practice of ensuring the product quality of waste paper. Accordingly, waste paper ceases to be waste when it is placed on a market where it has a demand because it fulfils certain product quality requirements, has a clearly identified origin and has been processed according to the required treatment processes. Compliance with all these requirements has to be ensured by applying industrial practice of quality control. The potential different elements of the end-of-waste criteria are discussed in detail in the following sections.

Non-paper layered material: shall it be included?

One of the most thorough debates held with the experts of the TWG has dealt with the potential inclusion or exclusion of waste paper grades that have a high content of materials different from paper, most specifically layered multi-material waste paper such as beverage cartons (25% non-paper), or plastic-layered kraft sacks (c.f. Section 2.6. on environmental and health issues).

Several experts of the TWG have advocated for the exclusion. The main argument is that the non-paper material cannot be turned into new paper at papermills. Once separated, the non-paper material ends in a pulper reject which has to be treated as waste. As of today, the most common fate for the plastic and metal layers is landfilling or at best energy recovery, as recycling technologies[54] for these materials have not yet reached maturity and spread. The market value of the material is also low, despite the high quality of the fibre content. Prices in the range 25-70€/t have been reported (Stora Enso, 2010). The reduction of price compared to the value of the paper content (100% waste paper would be >100€/kg) is due and depends on the cost of extraction of fibre and of reject disposal. Once separated by pulping from the paper fraction, there would be no control over the disposal of the non-paper materials.

It is therefore argued that the inherent environmental risk of inappropriate management is much higher than for other paper grades, which normally do not have more than 1 to 2% non-paper content. Most experts agreed to accept a 1-2% non-paper material content exported with waste paper, as removal beyond this point is too costly. However, most have reported that they would not accept the larger inherent environmental risk of layered waste paper.

Finally, some experts are concerned about the non-negligible residual content of liquids, food and of other organic matter attached to liquid packaging board through cross-contamination in multi-material sorting

[54] Examples of recycling exist, including pyrolysis, and production of roofing sheets.

plants. It is mentioned that this can be a concern in case the residuals carry overseas vermin cysts, insects or their eggs, etc., which are frequently attracted to the food and beverage residuals. The effects of overseas movement of such vermin factors across continents is undesirable, but if taking place, it is claimed that it should take place as waste and under the provisions of the Waste Shipment Regulation.

Other experts of the TWG claim that layered material contains valuable paper fibres.Layered waste paper is well characterised in EN643, has a market and a value, and its collection and recycling is common practice. Used beverage cartons contain always residuals of beverages, but so far, no incidents of environmental or health concerns have been registered in exports within or out of the EU. The total magnitude of the risk is somehow limited currently, as the amounts exported out of the EU are very small. Statistics from the beverage packaging indicate that currently, the export out of the EU of this material is lower than 5% of the total liquid carton packaging collected in the EU[55], resulting in ca. 17 000 tonnes in 2006, compared to a total of ca.10 mio tonnes waste paper exported. There is no reliable information on the imports of beverage cartons from outside the EU, or any future evolution of this trade. Other argument used is the potential negative effects to future recycling of the layered material, primarily related to not achieving the potential additional image benefits of EoW. Finally, it has been argued that exclusion from EoW would result in additional costs in restructuring existing collection systems in some countries and regions where e.g. beverage cartons are collected together with other waste paper types. As explained in detail in Section 4.2, this last argument is incorrect, as it wrongly assumes that EoW is compulsory to paper fulfilling the criteria. If these countries wish to continue current practice under waste law, they can do so.

Some experts of the TWG in favour of inclusion of layered material have proposed to address the additional inherent risk of the larger non-paper content by including additional EoW criteria only applicable to layered material, e.g. a contract with a papermill. This proposal is technically valid, but would conceptually and in practical terms be equivalent to the current data requirements under the Waste Shipment Regulation, i.e. under waste law.

In summary, there is agreement among the TWG experts on which are the fundamental elements that shall be part of the criteria for >99% of the waste paper streams, excluding layered waste paper types. However, there is not the same degree of agreement as regards the inclusion or exclusion of layered waste paper types. The technical data available show that layered waste paper fulfils most of the conditions of the WFD to a very similar extent than the rest of paper grades, however its has singular properties, in particular a higher content of non-paper material. This higher content results in a larger intrinsic risk of environmental impacts in case the material is exported, especially out of the EU. Some experts perceive and have expressed that this risk is not acceptable, and therefore support that layered waste paper types are kept within waste legislation.

Given the singularity of layered waste paper explained above and the additional intrinsic environmental risk derived from it, the proposal of end of waste criteria below excludes layered waste paper from its scope.

Outline of EoW criteria

Following the JRC methodology guidelines, the following complementary elements can be combined in a set of end-of-waste criteria:

(1) Product quality requirements
(2) Requirements on input materials
(3) Requirements on treatment processes and techniques
(4) Requirements on the provision of information (e.g. documentation of end use, traceability systems, labelling).
(5) Requirements on quality assurance procedures

The proposed end-of-waste criteria are presented individually below, with explanations of the outcome of the discussions held with the technical working group in the period November 2009-June 2010. Annex I

[55] ACE (2010) Alliance for Beverage Cartons and the Environment (ACE), Brussels, pers.comm.

presents a compact version of the criteria, without explanatory text, to allow a perception of the set of criteria as a package.

3.1. Product quality requirements

Product quality criteria are needed to check:

(1) For elements that can result in direct environmental and health risks, and
(2) That the product is suitable as direct input to recycled paper production.

Product quality requires that the fibres in waste paper are adequate alternative to primary raw-materials (virgin fibres), and that non-paper components limiting its usefulness have been effectively separated. This refers to the usefulness both in the short term (production of recycled paper) and in a long-term perspective that considers several cycles of collection and recycling and the progressive potential accumulation of trace elements that can not be removed from the cycle.

Direct quality criteria on waste paper includes thus quantitative limits on non-paper components, and it has been discussed whether it may also include criteria on the usable or unusable content of paper types, and of moisture. Such parameters describe the completeness of treatment, ensuring that the waste paper is fully characterised and fit for a safe direct use. Quantitative criteria may in principle be general or specific for the existing grades of waste paper, but the majority of the technical working group has expressed support for uniform criteria across grades, for the benefit of simplicity, and easier communication and implementation.

Following the comments received from the experts of the technical working group, there is broad agreement that:

- Waste paper shall be graded following EN-643. The standard is comprehensive in the sense that other specifications such as OCC 80/20 can always be associated to an EN-643 grade. While grading following EN-643 shall be made compulsory, such additional specifications may be added on a voluntary basis.
- Non-paper components have to be specified and limited.
- While grade-specific non-paper component content thresholds (e.g. between 0.5% and 2% depending on the grade) would better address the differences in quality currently found in waste paper grades, a cross-cutting uniform threshold for all grades of waste paper is a much easier concept as regards communication, implementation, and control.
- The mixture of two end-of-waste waste paper flows would become an end-of-waste flow only if a uniform non-paper component content threshold (e.g. 1%) is finally agreed for all grades. In case of split of thresholds for different grades, this equation would not necessarily hold. If both original EoW flows are of the same grade, the mix of them would be EoW of that same grade.
- Moisture does not need to be limited in EoW, as different mills tolerate it differently. A moisture content of 10% is used as reference in the EN-643 standard, to address the commercial importance of it: water contained in waste paper is a relatively dense material that paper mills do not reject but are not willing to pay for. Normally, only if deliberately watered or accidentally submerged or in prolonged contact with water can the 10-15% moisture content trespassed. In addition, too wet waste paper may be difficult to handle, as it would begin to crumble and fall apart. There is therefore no interest for the supplier (transporting water for which it will not get paid) or the buyer (receiving an inconvenient quality material) in allowing waste paper getting too wet. There is a limited environmental concern if waste paper is stored wet for a long period of time (several weeks), as under the pressure of storage under a pile of other bales, appropriate conditions for biodegradation are created, methane can be formed, and subsequent nuances (odours), and health and safety risks (fire) can be caused. However, it is normal industrial practice that if wet consignments are received at a paper mill, the material is always swiftly (within a few days or even a few hours) moved to the pulper. This is done on purely practical and economic grounds, to better tackle the handling inconvenience and simultaneously avoid any of the mentioned environmental and health risks. It is true that not including a moisture content threshold leaves an open risk of an EoW consignment becoming wet under unusual circumstances.

However, the current normal practice of handling such consignments, equivalent to that of any other commodity, is deemed sufficient and proportional to the potential environmental and health risk. The alternative of requiring moisture determination as part of the criteria would create a disproportionate additional administrative load with negligible value added in terms of environmental and health protection.

- The EoW criteria should not include a maximum limit on the content of "paper and board detrimental to production". Unusable paper does not need to be limited, as different mills tolerate it differently depending on their technology, and it does not pose a significant health or environmental impact. A growing number of mills have the equipment necessary to handle types of paper and board which in the past could have had adverse impacts on production, and this technology is developing all the time. This parameter is seen by the experts of the technical working group as a commercial issue which can be dealt with through suppler/buyer specifications. Within the broad category of "paper and board detrimental to production", some of the experts have highlighted the specific condition of carbonless copy paper, as it contains a high load of chemicals. They propose the exclusion of this paper type. Industry experts argue on the contrary that this paper type can indeed be handled by many papermills, and is a paper type in clear use decline.
- The size of paper is in almost all cases not of concern and should not be part of the quality criteria. The only exception heard of is finely shredded material from e.g. confidential document destruction, which is recyclable but is considered by some mills inferior due to the reduction of fibre length caused by fine shredding, and in some cases cannot find a recycling outlet. This parameter is seen by the experts of the technical working group as a commercial issue which can be dealt with through supplier/buyer specifications.
- The shape of the consignment shall not be addressed in the criteria. If appropriate, experts would support reference to guidelines such as CEPI's "Best practices – recovered paper baling conditions" for baled material, as standard sizes of bales improve efficiency in transport, handling and storage. However, criteria for end-of-waste shall not define mandatory conditions for baling and other shaping.
- The age of waste paper is a relevant commercial parameter for waste paper grades containing mechanical pulp, but this should not be part of the end-of-waste criteria.
- Waste paper must not present hazardous properties. Three options were proposed to the control of the risks derived from hazardousness: (1) a direct criterion on the quality of the material, which shall not display any hazardous properties, (2) a criterion on the exclusion of the use of hazardous material as input, and (3) a criterion on the processing for the removal of hazardous material. Alternatives (2) and (3) have drawbacks as stand-alone alternatives. Alternative (2) is difficult to control by reprocessors and is currently often not controlled, because of the nature of waste paper as originated from many different users, which accidentally may mix in the stream hazardous components (e.g. a battery). If taken, this alternative can not stand alone, because in the case an EoW consignment is judged hazardous upon control by the authorities, the reprocessor cannot be freed from responsibility by claiming that the input was controlled. The output, which is candidate to cease to be waste, has to be controlled too, and this is in line with visual inspection practices prior dispatch of consignments. Alternative (3) is not currently operational in reprocessing plants, which are designed to separate independent, foreign hazardous elements such as batteries, but currently (perhaps with exceptions) are not prepared to avoid that paper impregnated with solvents or toxic powders ends in their output. Option (1) requiring non-hazardousness of the output material, which is in all cases object of visual inspection, seems therefore necessary. In addition, the inclusion of a criterion on the input (option 2) is considered also necessary as a complement, in order to better tackle the risk of cases of dilution, i.e. hazardous elements are allowed into the reprocessing, but by dilution these are not detected in the output, which then can become EoW material. Some stakeholders point out the difficulty in detecting hazardousness (e.g. mineral oil aromatic hydrocarbons (MOAH) in ink) with visual inspection. This is correct, but the alternative is including additional measurements, which by many is considered disproportionate given (a) the well established practice of recycling, where experienced staff is able to detect most non-compliance, and (b) the fact that with the restriction of scope proposed, these substances will not be released to the environment directly. They will be collected, after the pulper or de-inking stage, in rejects, which are waste and have to be dealt with as such.
- The material has to be free of visible chemical or biological contamination such as oil, solvents, paint, or biodegradable substances resulting in mould growth. Some of them may be detected by the presence of odour. These elements are not sufficiently covered by the requirement on hazardous properties. The

experts have not suggested any alternative proposal on criteria to control these issues in a more simple/effective way, and therefore this criterion has been kept as part of the quality requirements.

As presented in the introduction, there is no agreement in the TWG on whether layered materials should or not be included.

Content of non-paper components

The technical working group has widely supported the proposal of a criterion on the maximum allowable content of non-paper components. This is the only quantitative criterion requested to EoW paper. The criterion is connected to the fulfilment of two of the conditions of EoW, namely

> (1) ensuring that the material is essentially composed of a recyclable material, in this case paper fibres (i.e. cellulose fibres, lignin, and inert additives such as clay, starch, or calcium carbonate) with only a minor content of other non-recyclable materials, and for this reason a valuable input to papermaking, and
>
> (2) limiting the amount of pulper rejects that need ulterior waste treatment, as waste treatment has environmental impacts, and it can not be controlled once it is exported out of the EU.

The definition of non-paper components has been discussed in-depth in the technical working group. Two options have been discussed:

> (1) a definition based on limiting the content of any material different from paper, be it foreign or an integral part of the paper product of origin.
>
> (2) a definition based on limiting only the non-paper materials that are foreign to the original paper products and can be separated using dry sorting techniques. This could mean that non-paper materials bound to the paper (glued plastic film or metal layers, metal or plastic binding spirals, thread and glue book binding, tape attached to card boxes, etc.) and which can only be removed in a wet process such as a pulper, would not compute to the total of non-paper components. In case one opts for exclusion of e.g. layered materials such as beverage cartons from EoW, this definition would have to explicitly specify as non-paper component the whole layered product (e.g. beverage cartons, coated paper sacks).

Having said this, not all bound material can be efficiently separated in wet phase. The extent of separation of bound material depends on the wet phase techniques used at the papermill. Most pulpers can e.g. easily separate tape, metals, and one-sided coatings, but are unable to separate double-layered material such as liquid board packaging where a paper layer is shielded completely from water intrusion. Access of the pulper water to these fibres requires an extension of the residence time in the pulper, sometimes compensated for with the help of pre-treatment of the material by e.g. shredding and/or screening[56]. In general and except for liquid board packaging and other few, very specific coated papers (e.g. in ice-cream packaging, coated sacks), the content of non-paper components bound to the paper is very moderate, in most grades under 0.5% in weight.

The choice of any of the two presented definitions has advantages and drawbacks. The first definition addresses consistently the need to limit the amount of pulper rejects that require waste treatment, regardless of its nature. It thereby limits the environmental impacts derived from such waste treatment, in particular the risk that this treatment is not equivalent to EU practice when the paper is shipped out of the EU, where EU waste legislation does not apply (e.g. Art. 49 of the Waste Shipment Regulation) and the environmental and health impact of waste treatment cannot be controlled. On the drawbacks side, this definition does not fully fit with the parameter normally targeted in quality control in industry to set the

[56] European mills equipped or adjusted for treating liquid board packaging are approx. 20 out of the 400 papermills that use waste paper. These 20 plants treat approx. 350 000 tonnes of liquid board packaging, out of the ca. 60 million tonnes of waste paper used in Europe for recycling.

price of waste paper. Papermills do not in general request reprocessors to remove bound non-paper components that are not possible to remove in dry phase, as this would be technically possible but totally unfeasible from an economic perspective. This option not based on dry sorting would exclude most layered materials up to the threshold (e.g. if a 1.5% total limit is used, it would allow up to 6% in total weight of beverage cartons mixed with other 100% fibre waste paper, while a dry sorting definition of 1.5% would assume all mass in a beverage carton is not paper, and thus only allow 1.5% in total weight of beverage cartons, containing 0.375% plastic).

The second definition presented is closer to the target of commercial transactions in the paper chain. However, this second definition fails in addressing consistently the concern of the need of waste treatment of the non-paper content. This is because some consignments may contain very little or no bound non-paper material (e.g. used office paper), while other grades may contain very much non-paper material (e.g. used notebooks with metal spirals and plastic covers), and both would be measured as containing the same amount of dry-sortable material, while the generation of rejects is very different in both cases. If this concern was a priority, the first definition is needed.

If one is to propose criteria based on the second definition, one needs to explicitly mention the layered material under the definition of non-paper components, under the quality requirements. This is meant necessary despite resulting in a more cumbersome and counter-intuitive listing of the examples of non-paper components, as layered waste paper contains indeed paper. The alternative option of excluding the layered material through control of input materials is difficult because of the heterogeneous nature of most waste paper grades. In addition, such option would not be effective in avoiding dilution or mixing of layered material in consignments not containing layered material, despite the existence of a criterion on processes and techniques that explicitly forbids mixing.

A correlation, or conversion rule is in any case necessary between the sampling technique in place, the parameter used for commercial transactions, and the non-paper component measurement. There is variability in the choice that mills or reprocessors make of the parameter controlled, as some mills can handle non-paper components that some others cannot. The type of sampling can influence what is considered a non-paper component. For instance, core drilling may separate a piece of metal spiral from a notebook, and record it as a non-paper material, while manual sampling would have considered this a non-paper component bound to the paper. Another example is multi-layered material. A mill able to use the paper contained in this material would consider its as usable paper, whereas a mill equipped with a pulper that cannot separate the paper and non-paper layers would consider the whole layered material product as a non-paper component.

In the consultation round held in July 2010, all industrial stakeholders and some Member State representatives have supported a definition based on dry sorting, and no stakeholder from the TWG has opposed this definition. No explicit support for definition (1) based on the total non-paper material content has been received. The support of industry stakeholders to the definition based on dry sorting is largely based on better alignment with current monitoring practice. In assuring this, monitoring of quality for EoW would be a less burdensome process.

Based on an overall assessment of the pros and cons of both options, and the response from the experts, the second definition is here proposed, i.e. *a **non-paper component** is any material different from paper, which is present in waste paper, and can be separated using dry sorting techniques*.

Non-paper components normally include all non-paper materials not part of the original paper products, but it can also include non-paper parts of the product that fall out of it during treatment, or waste paper types that are only suited for papermaking in specific treatment conditions, because of the high content of plastics. Should one exclude waste paper layered and coated with plastics (coated sacks, liquid packaging board), a simple and effective way of doing so is that these also count as part of the non-paper component content.

The inclusion in the definition of an additional specification that non-paper components are only those *not part of the paper product* is proposed by some stakeholders, but this is controversial. The added value of a specification on being part of the original product is not seen to provide a benefit in terms of clarity of the

dry separation process: if a material can technically be separated in dry phase, it will be separated, no matter if part or not part of a paper product. If a material is parts of the product, the dry sorting will determine if it is possible to separate, not the origin. This concept is thus not linked transparently to a technical option.

In addition, such specification may reduce the interest in developing new techniques for dry separation of non-paper materials in paper products. It will also ignore the efforts made in the paper chain for the eco-design of paper products, so these are less complex and dependent on other materials, easier to dismantle into different materials after use, and all in all easier to recycle.

Limit value non-paper components

The nature of non-paper materials varies from grade to grade, with the source of the material playing the most important role. The most common non-paper materials are plastics, wood, and metals, but the list of materials found in trace amounts is long and includes also glass, textiles, earth, sand, dust, wax, bitumen, ceramics, rubber, or fabric.

Such material has to be distinguished from mineral fillers and additives bound to paper fibres during the manufacture of paper, such as china clay, calcium carbonate, or starch. These mineral fillers and additives are to be considered as part of paper, and are out of the scope of non-paper components. Ink is likewise out of the scope of non-paper components.

The non-paper component content is to be measured as dry air weight. Drying to dry air condition is undertaken customarily by papermills and reprocesses for sample measurement of moisture. Dry air condition can be ensured by e.g. residence at 105±5^{o}C for 30 minutes in an oven, but can likewise be achieved by simple and affordable alternative procedures such as residence in a microwave for a few minutes.

The maximum content of non-paper components allowable, yet considering the material ready for direct input to a pulper, depends on the type of paper produced. Papermills producing printing products and using high qualities will be less tolerant than producers that use mixed grades as main input (e.g. newsprint, card). Some sources consulted indicate that the latter can handle non-paper component contents of up to 3% without much technical disturbance, even though this is not welcome, as it results in higher amounts of rejects that need disposal. In these plants and many other using post-consumer mixed material, non-paper component contents above 3% are taken with concern, and above 5%-6% are usually not tolerated except in plants specially equipped for non-paper component removal.

From the two meetings with stakeholders and a thorough analysis of the sector, it has been found that most currently traded waste paper has a non-paper component content between 0.25 and 2.5%, the vast majority being below 2%.

Using the best available data, the threshold percentage of non-paper components that would be reasonable to set as part of the EoW criteria has been assessed. The criterion shall be as simple as possible, and do not create an additional administrative burden. The criteria should ideally be at reach for a large part of the recovered paper flow currently used for papermaking, and perceived by the sector as a raw material, not waste. However, the threshold should:

- be sufficiently strict to avoid that too dirty material is classified as non-waste, especially concerning the risk of shipment of non-paper material out of the EU as part of a product. Only the cleanest material currently used and perceived as raw material should pass.

- not discourage technology development towards producing cleaner material that could fulfil the threshold, to affect the efforts made in the last decades towards increasing waste paper collection, increased quality in the collected waste paper, the technologies for use of waste paper for papermaking, and the demand of recycled paper products.

- not make EoW a luxury issue only for the benefit of a marginal part of the total paper flows, and out of reach for the majority of the paper flow currently perceived and used by the sector as a product.

Based on these requirements, one of the key elements that have been investigated is the amount of waste paper currently used in the EU for papermaking that would fulfil different non-paper component limits in the range 0.5 -2.5%. The concept is illustrated in graphical form in Figure 11 below:

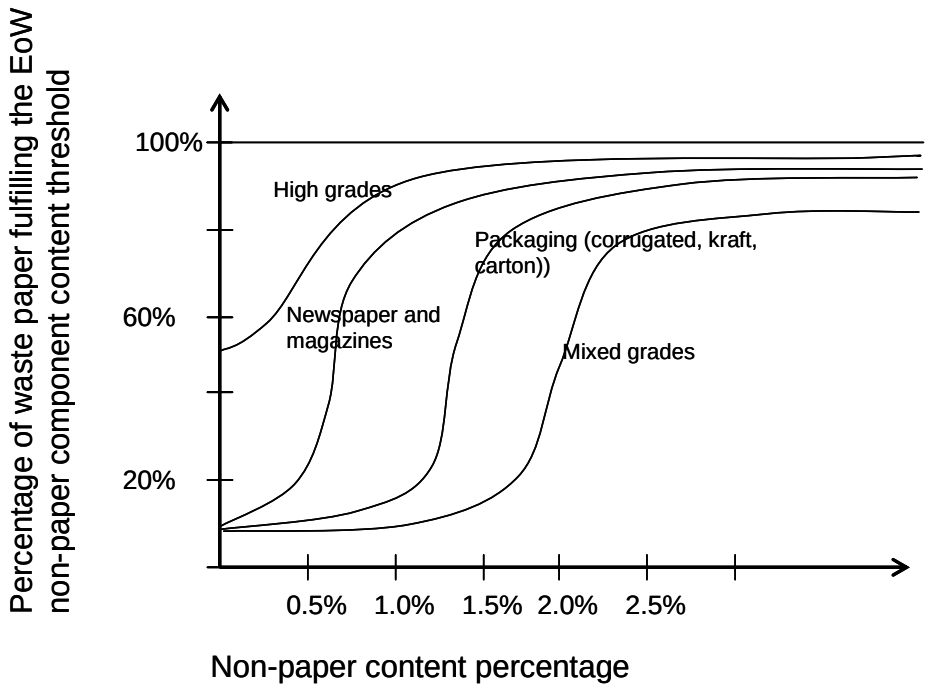


Figure 11. Fictive illustration of the percentage of waste paper fulfilling the EoW non-paper component content threshold, as a function of these thresholds.

The figure above has been prepared for the sole purpose of illustrating the concept. The values used are gross average estimates based on the best available information received from experts from a variety of backgrounds (reprocessors, papermakers, available statistics, academia). However, it is acknowledged that many variables may play a role in moving these curves upwards, downwards or sidewards, including paper grade, paper collection systems, seasonal variations, etc., making a precise sketching of this curve difficult or even impossible.

Several options of thresholds have been assessed, including the most simple single cross-cutting values, two-value sets, four-value sets, and progressive sets that are less strict in a first phase, and stricter after some years of adaptation time.

A single value is easy to understand, communicate, implement and control However, it is also acknowledged that a single value can hardly address the intrinsic differences of the streams, therefore it cannot deliver to all grades the same incentive to improvement of e.g. sorting, or the parameters that distinguish for each grade a product vs waste.

As most comments received from experts support clearly a single value for use in all grades, only this option has been analysed further. Three single-value thresholds have been evaluated in detail:

- 1 %
- 1.5 %
- 2 %

The advantages and disadvantages identified for the three options are presented in Table 8 below, as well as some reflections on the simplicity and operational suitability of the options, and the possible effects on the two large families of waste paper grades (packaging and de-inking) and on multi-material systems.

Table 8. Advantages and disadvantages identified for three options of a non-paper component content threshold.

Option	Advantages	Disadvantages	Simplicity / operational suitability. How does the option affect visual inspection vs gravimetry?
Option 1) 1% for all grades			
Effects on… **General**	The benefits of source separation systems, that can deliver higher quality, become clear, compared to comingled systems Reduced shipment of non-paper material as a paper product	Large flows of material with >1%, which are currently perceived as products by industry, will remain waste, especially mixed and card grades. The market will be split artificially, with no link to the actual usability of grades for papermaking. This may discourage move towards EoW	Few cases (10-20% of the total flows) will be clearly product s without needing gravimetry except occasionally: high grades, high quality deinking grades, most of them pre-consumer waste. These can be identified visually and have a speedier quality check procedure. About half of the deinking grades and the bulk of card grades are close or above the 1% threshold, and will require frequent gravimetric analysis to confirm if waste or non-waste.
Multi-material systems		Very far from technically achievable, may discourage efforts for improvement.	
De-inking grades	Adequately strict		
Packaging grades		Probably too strict, except for pre-consumer grades and very refined sorting. Consequence: very little benefit from EoW, despite most material under 3% being currently considered a good raw material for the industry, and with little environmental concerns.	

Option 2) 2% for all grades			
Effects on… **General**	The bulk of waste paper flows (municipal and commercial deinking grades and packaging card), perhaps up to 80% of flows, would have chances of becoming EoW	The benefits of using source separation systems, which deliver much better quality than 2%, are perhaps not highlighted with this threshold. Papermills using deinking grades may not detect much improvement Larger shipment of non-paper material as a paper product compared to all other threshold options	Most of the largest flows currently considered as products, especially the large groups of deinking grades and packaging card, will have a chance to be product s. Perhaps only <20% of card grades and <10% of printed grades will remain waste. Grades far under the threshold can be identified visually and require very sparse gravimetry, especially the bulk of deinking grades, smoothing the costs of quality check demands. Reprocessors will benefit from less demanding gravimetry on deinking grades and high quality grades
Multi-material systems	Comingled systems will have an incentive to deliver high quality, as 2% is reachable at good MRFs for most printed material, and to some extent for card/packaging. Is perhaps the most appropriate single threshold for both printed and packaging material from MRFs if the objective is to encourage better sorting.		
De-inking grades		Many deinking grades probably far below this threshold. Possible negative consequence: lack of incentives for improvement. Potential risk of decrease in average quality by mixing of subgrades, since the threshold is high and distant.	Positive consequence: visual inspection may suffice for these grades, and longer time between gravimetric inspection will be needed, therefore speedier quality control.
Packaging grades	Adequately strict for the packaging grades.		

	Estimated 80% of material from commerce and separate collection will pass.		

Option 3) 1.5% for all grades			
Effects on… **General**	A large part of grades (probably up to 70% of flows) may become products, including the high grades, most deinking grades, and about half of the card packaging grades. It maintains a speedy line with much visual inspection and very little gravimetry for the high grades (mostly pre-consumer). Can be a reasonable compromise between sufficient strictness and the provision of an operational system, as the 2% is considered by many as bearing a non acceptable risk of export of non-paper material, resulting in removal and disposal costs for papermills and non-EU importing countries (waste export out of the EU).		The threshold is sufficiently high to allow that all pre-consumer grades can be identified visually and require very sparse gravimetry, whereas the mixed grades require more often quantitative control. Many mixed card grades and some very mixed printed grades are close to the threshold and will require frequent gravimetry.
Multi-material systems	For mixed grades is probably the most appropriate threshold to encourage improvement.	Only the very good processors will reach the threshold	
De-inking grades		Perhaps too lax for the deinking grades. The consequence may be a lack of incentives for improvement of quality of these grades.	
Packaging grades	Probably tin the limit of strictness for these grades.	Expert estimates received indicate that for the packaging products, this threshold would leave ca. 50% out of the EoW status, despite all packaging material roughly under 3% being currently good raw material for papermaking. On the other hand, about a half of these grades would benefit from EoW, notably the clean packaging grades far from the threshold, which would benefit of reduced control burdens.	

The comments received from the technical working group are split. Some stakeholders defend with priority the importance of guaranteeing quality both for the EU market and for shipments, in order to reverse the trend of poorer quality of waste paper observed in the last years, and are in favour of a threshold of 1 or 1.5%. Some other stakeholders highlight the benefits in terms of a swifter procedure under visual inspection to high quality material if the threshold is in the range of 1.5 to 2%, and stress the risk of that technical progress is slower in e.g. comingled systems if the threshold is far too strict.

With the data available, and after consideration of the pros and cons of the options described in Table 8, **it is proposed to establish a non-paper component threshold of 1.5%, to be used for all waste paper grades, using the definition presented above based on dry sorting**.

This single threshold balances the advantages and disadvantages detected within the range of options considered, addresses conservatively but with proportion the potential risk of unintended impact to health and the environment, and maintains the provision of a reasonable degree of latitude to the paper industry - in particular the reprocessors - to refine the existing techniques and trade a majority of their output as non-waste.

This is the only quantitative criterion proposed, and as such it is potentially the most burdensome in terms of monitoring costs. However, including this criterion has relieved the inclusion of other alternative criteria, as it ensures that EoW paper is essentially composed of paper fibre and very little else. This information, together with knowledge of the existing collection and reprocessing systems in use in the paper sector in the EU, ensures that the fibre is of adequate quality for use as direct input for papermaking. A low content of non-paper components limits the amount of non-paper transported out of the EU, and limits the amount of pulper rejects, which need treatment for recovery or disposal. The use of a quantitative criterion is in line with recent studies on the quality of output of MRFs (WRAP, 2009) and the use of this parameter as benchmark in waste paper grading specifications such as ISRI and the EN-643 update.

Setting single threshold has benefits and limitations. On the negative side, it discriminates waste paper containing e.g. an average of 1.55 % non-paper components, which is a valuable raw material for papermills. However, it is beneficial as conveying a simple and clear message that sets the benchmark of what is considered high quality, and a low risk for health or the environment. It has to be understood that what the key issue is the distance to the threshold. If a material is still waste, as a driver for improvement, and if it has ceased to be waste, as a mechanism to manage and reduce the frequency of sampling.

The non-paper component content has to be ensured for each consignment as part of a quality assurance programme, but this does not mean that each consignment has been tested. If the producer can ensure through a statistically sound sampling plan available to auditing that the average value of deliverables of the same grade and origin, including the confidence intervals, is below the threshold, this should be accepted. A risk-based sampling approach is thus suggested. Compared to random sampling, risk-based sampling can reduce both the sample size and the frequency of sampling in continuous survey plans, e.g. in consignments part of long-term delivery contracts. In the risk-based approach, information from previous surveys can reduce the sample size and frequency of sampling of the new surveys, while maintaining the overall level of confidence.

Normally a confidence level of 95% is used, indicating that the probability that the mean value of the content of non-paper components in a sample is below the legal limit is 95%, or conversely, that the probability of the mean value of the sample being above the threshold is 5%. This implies that the mean concentration of the whole consignment plus the confidence interval needs to be below the theshold.

Usually, it is impractical to sample from the total consignment and a subset of it that can be considered representative will have to be defined as part of the quality assurance process. The scale of sampling needs to be chosen depending on the sales/dispatch structure of a reprocessor. The scale should correspond to the minimum quantity of material below which variations are judged to be unimportant.

The better the precision of the testing programme (the smaller the standard deviation and the narrower the confidence interval), the closer the mean concentrations may be allowed to be to the legal limit values. The

costs of a testing programme of waste paper with very good quality (parameter values far from the limits) can therefore be held lower than for waste paper with values that are closer to the limit.

When a new reprocessing line or plant is licensed there is usually an initial phase of intensive testing to achieve a basic characterisation (for example one year) of the waste paper generated. If this proves satisfactory, the further testing requirements are then usually reduced.

Visual inspection will be required in all cases, regardless of the frequency of the quantitative control done in parallel. Recent conclusions of a study comparing visual vs. quantitative inspection of MFR output (WRAP, 2009) indicate that large discrepancies are observed between these two methods of inspection. Large discrepancies are also observed within the methods, especially in visual inspection (e.g. paper mill vs. reprocessor of the same consignment). Visual inspection is thus to be regarded as a complement and never a full substitute of quantitative control.

It is in the spirit of the criteria proposed that facilities using multi-material sources should have continuous non-paper component testing on output qualifying for EoW. It is envisaged that mono-material mixed waste paper sources from households and commerce will require a more modest sampling effort, but regular enough to be able to detect trends and non-conformities. Conversely, the testing of high grades will be minimal, as their average non-paper content is in the range of e.g. 0.25-0.5% and therefore far from the proposed threshold.

Sampling results have to be recorded, kept for the competent authorities and made available on their request. The sampling procedures and calibration methods shall be made available to auditing, e.g. by making them part of quality management procedures such as ISO 9001 that requiring auditing.

It is important to underline that in a pulper, waste paper that has ceased to be waste will be mixed with water and be disaggregated, resulting in two output streams: a paper fibre (with some minerals) stream for production of new paper, and a reject stream essentially containing the non-paper components. **The reject stream after the pulper, once separated, does not retain the non-waste status, i.e. it is to be considered waste.**

Based on the discussed issues, the criteria on quality proposed are the following:

Criteria	**Self-monitoring requirements**
1. Quality of waste paper resulting from the recovery operation	
1.1 The waste paper **shall be graded** according to the European specification[57] "*EN-643- Paper and board - European list of standard grades of recovered paper and board*".	Qualified staff[58] shall grade each consignment.
1.2 The **non-paper component** content shall be ≤ 1.5 % of air dried weight. A **non-paper component** is any material different from paper, which is present in waste paper, and can be separated using dry sorting techniques. Examples of non-paper components are metals, plastic, glass, textiles, earth, sand, ash, dust, wax, bitumen, ceramics,	Qualified staff shall carry out visual inspection[59] of each consignment. At appropriate intervals subject to review if significant changes in the operating process are made, representative samples of each grade of waste paper shall be analysed gravimetrically to measure the content of non-paper components. The non-paper components content shall be analysed by weighing after mechanical or manual (as

57 NOTE: if possible, it would be desirable to formulate the reference to EN-643 in a way that is not dependent on its update.
58 Qualified staff means staff which is qualified by experience or training to monitor and assess the properties of waste paper
59 "visual inspection" means inspection of consignments using either or all human senses such as vision, touch and smell and any non-specialised equipment. Visual inspection shall be carried out in such a way that all representative parts of a consignment are covered. This may often best be achieved in the delivery area during loading or unloading and before packing. It may involve manual manipulations such as the opening of containers, other sensorial controls (feel, smell) or the use of appropriate portable sensors.

rubber, fabric, wood, and synthetic organic substances. Mineral fillers bound to paper fibres such as clay, calcium carbonate, and starch are considered as part of paper and do not count as non-paper components. Packaging board and paper sacks consisting of layers of paper and of non-paper materials, such as beverage cartons, count as non-paper components.		appropriate) separation of materials under careful visual inspection. The appropriate frequencies of monitoring by sampling shall be established taking into account the following factors: (1) the expected pattern of variability (for example as shown by historical results); (2) the inherent risk of variability in the quality of the waste used as input for the recovery operation and any subsequent processing, for instance the higher average content of plastics or glass in waste paper from multi-material collection systems; (3) the inherent precision of the monitoring method; and (4) the proximity of results to the limitation of the non-paper components content to a maximum of 1.5 % of air dried weight. The process of determining monitoring frequencies should be documented as part of the quality management system and should be available for auditing.
1.3	The waste paper, including its constituents and in particular ink and dyes, shall not display any of the **hazardous properties** listed in Annex III to Directive 2008/98/EC. The waste paper shall comply with the concentration limits laid down in Commission Decision 2000/532/EC[60] , and not exceed the concentration limits laid down in Annex IV of Regulation 850/2004/EC[61].	Qualified staff shall carry out a visual inspection of each consignment. Where visual inspection reveals any indications for possible hazardous properties further appropriate monitoring measures have to be taken, including, if appropriate, sampling and testing. The staff shall be trained on potential hazardous properties that may be associated with waste paper and on material components or features that allow recognising the hazardous properties. The procedure of recognising hazardous materials shall be documented under the quality management system.
1.4	Waste paper must not contain absorbed oil, solvents, paint, aqueous and/or fatty foodstuffs, that can be detected by visual inspection.	Qualified staff shall carry out a visual inspection of each consignment. Where visual inspection reveals signs of fluid absorption except water, that may result in e.g. mould growth or odours, and these signs are non-negligible, the consignment shall remain waste. The staff shall be trained on potential types of contamination that may be associated with waste paper and on material components or features that allow recognising the contaminants. The procedure of recognising contamination shall be documented under the quality management system.

[60] OJ L 226, 6.9.2000, p. 3.
[61] OJ L L 229, 30.4.2004, p. 1.

3.2. Requirements on input materials

The purpose of criteria on input materials is to check indirectly the quality of the product.

Two main options exist, and have been discussed with the technical working group. Input material criteria may address any input source and limit the materials in them that pose a specific environmental, health or quality concern if not treated adequately, or limit specific input sources (that is, a *negative list* approach). The second approach is to refer to the types of input materials that are preferred because their origin ensures absence or minimisation of risks, e.g. a requirement that only selective collection sources are accepted for EoW (*positive list* approach).

A positive list approach bears the risk of letting aside suitable sources of waste paper, or sources which can become suitable as new technologies become available. Negative lists bear the concern of not excluding all potentially unsuitable materials.

In the two workshops held, the opinions received from the experts of the technical working group were not in favour of a positive list. In a way, the direct requirement of grading according to EN-643 is a form of positive selection, as only the material that qualifies for the standard, which is known to be useful input to papermaking, is allowed. The requirement of grading according to EN-643 reduces largely the need and purpose of additional criteria on input materials. On the other hand, a negative list may be proposed and cite exclusively the materials that under no circumstances should enter paper manufacturing. This can be a useful complement of the requirement of grading according to EN-643, addressing issues not sufficiently included in the standard such as hazardous waste. The revised EN-643 may expand and be more precise on its requirements to input, but for the time being, these "negative list type" complementary requirements are needed.

The end-of-waste criteria should allow as input only waste streams containing paper that can be processed for the production of new paper in compliance with the product quality requirements, after appropriate treatment, and without overall adverse environmental or human health impacts.

After consultation with the technical working group, most experts agree that no currently traded paper grades have been identified as non-suitable for EoW because of their origin, as there is a market for all grades in EN-643. Concerns were raised by some experts to the suitability of:

- Grade 1.01 [mixed paper and board, but unusable materials removed] because of its mixed content,
- Grade 5.01 (unsorted paper and board, separated at source), which often contains food rests.
- Grade 5.03 [used liquid packaging board including used PE-coated liquid packaging board (with or without aluminium content), containing a minimum of 50% by weight of fibres, and the balance being aluminium or coatings] because of the concerns of inappropriate disposal of the very high content of non-paper materials, c.f. section 2.6 above)
- Grade 5.02, because of the frequent presence of liquid packaging board, albeit in lesser amounts than 5.03
- Grade 2.9 [carbonless copy paper], because of its high content of chemicals, compared to normal printed paper. This paper type is used currently in very small amounts, and its use is decreasing with the development of digital technologies.
- Grades 4.04.01 [used kraft sacks with polycolated papers] and 4.05.01 [unused kraft sacks with polycolated papers], because of the high content (~5%) of plastic layer(s).

However, in general it is acknowledged that if appropriate measures in terms of e.g. technology and man-power are taken to perform sorting and avoid cross-contamination, a high quality material can be obtained from very diverse origins, including the grades mentioned.

Restriction of sources

The technical working group supported to exclude certain origins of waste paper, the presence of which can potentially represent a risk for health, safety and environment, and include:

- hazardous waste, including toxic materials
- biowaste (organic waste including food or beverage waste)
- mixed municipal waste
- health care waste
- used products of personal hygiene

The technical working group largely supported to limit the allowable collection systems for waste paper to two origins:

- single-material collection systems for waste paper, making use of the broad definition of waste paper that encompasses all paper fibre materials. These collection systems keep waste paper separate from other materials until delivery to papermaking.
- multi-material (e.g. comingled) collection systems of recyclable materials. These collection systems separate waste paper from other materials, and keep it then separate until delivery to papermaking.

In both cases, waste paper may be further sorted into different paper materials, but may not be mixed with other materials. In light of the strictness of the quality criteria proposed, most notably grading and non-paper content, it is considered redundant to include a requirement on the allowable origin. It is evident from current industrial practice that only separate collection in mono-material or multi-material recyclable collection can achieve the quality required by a simultaneous application of EN-643 grading and a 1.5 % threshold for non-paper components. For the benefit of a simpler and clearer legislative proposal, it is proposed not to include any limitation to the allowable collection systems.

Regarding the question on whether waste paper from multi-material collection systems shall or not be restricted, while taking note that on single material source collection delivers better average quality than multi-material systems, the large quality variations reported in practice between different multi-material waste treatment sites (MRFs) would not support the exclusion *a priori* of these systems. If delivering high quality, these systems should be allowed, and given some degree of freedom to improve their sorting techniques.

Unlike shipment of waste paper from multi-material systems as waste, material from this origin that is shipped as EoW fulfils a number of additional quality, input, treatment and quality assurance criteria that ensure that the materials has high quality. In addition, there is compulsory labelling of the origin.

The technical working group comments received reflect mixed opinions, but in general it is considered acceptable that if waste paper form multi-material systems is able to cope with the strictness of EoW quality criteria, it should be allowed as input. It is thus proposed that multi-material sources are not excluded as possible input to EoW. The exclusion of multi-material origin would send the signal that only mono-material sources deliver the right quality. On the other hand, while multi-material systems are not optimal from the point of view of achieving high quality output of any of the recyclables (in particular waste paper), one can not ignore the existence of separation techniques that are currently able to deliver waste paper of high quality, comparable to mono-material systems. EoW criteria should not discourage further technology development to improve quality of waste paper from any origin.

The data below (Table 9) summarises the results of a sampling project on the composition of the recyclable output from MRFs in the UK (WRAP, 2009b).

Table 9. Summary of the results of a sampling project on the composition of the recyclable output from MRFs in the UK. Source: WRAP, 2009b. **Note: Type 1 MRFs: single stream of all recyclables together. Type 2 MRFs: separate lines for paper fibre recyclables, and rest of recyclables**

Composition of 'paper and card' based outputs as by each 'paper and card' category and non-'paper and card' categories

Paper and Card Outputs	Card % Composition			Mixed Paper % Composition			News and PAMs % Composition		
	Full Data	Type 1 MRFs	Type 2 MRFs	Full Data	Type 1 MRFs	Type 2 MRF	Full Data	Type 1 MRFs	Type 2 MRF
Brown Board	**71.35**	**69.83**	**75.13**	10.76	10.67	13.75	2.13	2.04	2.49
G&W Board	**16.12**	**17.18**	**13.49**	10.45	10.40	12.18	3.67	3.30	5.18
News & Mags	3.90	3.03	6.05	56.64	56.41	63.89	**84.54**	**85.52**	**80.61**
Other Recy Paper	2.62	2.21	3.64	10.49	10.58	7.61	6.22	5.31	9.89
Non-targeted fibre	2.69	3.73	0.10	1.70	1.75	0.28	1.23	1.48	0.22
Non-Paper & Card	*3.33*	*4.02*	*1.61*	*9.95*	*10.19*	*2.30*	*2.21*	*2.36*	*1.62*

The results from Table 9 indicate that MRFs with a separate line for paper fibre recyclables are able, on average, to deliver high quality Card (1.61 % non-paper material) and News and Pams (1.62% non-paper material) streams.

If in the medium term the amounts of waste paper from multi-material origin that are able to meet the EoW criteria do not grow (be it for technical or economic reasons), then it will be clear that multi-material systems have limitations, providing an argument to those municipalities choosing mono-material systems. If on the other hand the amounts increase, this will enabling additional sources not at reach with other collection methods, and provide a wider spectrum of valid options to municipalities. An upfront exclusion, not based on an evaluation of performance but on the currently delivered average quality, is seen disproportionate.

Some experts of the technical working group have supported the need of labelling specifically waste paper form multi-material systems, to better tackle a higher risk of non-paper component content and cross-contamination of the material as part of the quality management systems of papermills, and better identify the nature of this contamination (e.g. an average larger content of glass, which is detrimental to production in papermills). In fact, it would be a highlight of existing requirements of EN-643. Additional information on the labelling is provided in section 3.4 below.

Food and beverage

A number of stakeholders have expressed their concern to the candidacy for EoW of packaging of foodstuffs and beverages, in case there is non-negligible residual content of liquids, food and of other organic matter attached to it from its original content or through cross-contamination in multi-material sorting plants.

Most stakeholders have agreed in the expert meetings that foodstuff residuals are unwanted material in papermaking. Nevertheless, the presence of organic material in very small amounts is tolerated, as small amounts are very difficult or impossible to avoid in mixed grades from household and commerce (e.g. pizza boxes, supermarket fruit boxes), where its full removal would be very costly.

Only a restricted number of papermills use currently waste paper with visible contamination levels of food or beverage residuals. One of such cases is post-consumer liquid packaging board, in particular if collected with other waste in multi-material systems (e.g. yellow bags for packaging waste in Germany or Spain) where it gets additional cross-contamination. Cross-contamination of readily degradable matter results in the need to address disamenities (e.g. odour, leaching, vermin attraction) for a safe use of this material. Such measures are commonplace, most importantly by logistics, to speed up the stages of collection, separation, and storage, in order to shorten to 2-4 weeks the time between disposal of the packaging by consumers and the use of the packaging in the pulper of a papermill. Other measures such as rinsing, shredding and pre-screening are sometimes used prior pulping to be able to remove the high contents of beverage residuals and other food cross-contamination attached to beverage packaging during collection and sorting.

It is important to mention that e.g. liquid board packaging has a plastic laminate between paper fibres and the liquid it contains. This laminate protects the fibres against any food or liquid residues or cross-contamination once it is waste, so the quality of the fibre is not altered by the content of food residues that a

given consignment of this grade of waste paper may have. By shredding or a long pulper residence time, the paper is made available to water, and the metal and plastic film can be separated. Organic contamination is thus not a quality concern with respect to the final paper product, but a concern of the environment and working environment in the handling of post-consumer material.

Currently, the control of disamenities of food and beverage content is ensured by plant permits and waste law, which ensure specific environmental protection measures in storage and transport. So far, no cases of complaints due to disamenities have been detected in the liquid board packaging chain within the EU, proving the effectiveness of current logistic management. The measures taken at the reprocessing plants and the papermills are specified in the permits of operation, and would not change by waste paper becoming EoW.

In transport for shipments out of the EU lasting several weeks or months, the mentioned protection of health and the environment cannot be ensured if the material ceases to be waste. Used food and beverage packaging (e.g. EN-643 grade 5.03) have often visible content of food/beverage residuals. If this material became EoW it could move freely, also out of the EU or in from outside the EU, without the requirements of environmental and health protection given by waste legislation. This can be a concern in case the residuals carry vermin cysts, insects or their eggs, etc., which are frequently attracted to the readily degradable material (food, beverage residuals). The effects of overseas shipment of such vermin factors across continents are undesirable, and in order to handle them, such transport takes currently place as waste, i.e. under the provisions of the Waste Shipment Regulation.

Based on the presented analysis, it is proposed to exclude the presence of visible food and beverage residuals in waste paper that is to become EoW. The proposed criteria on input materials are the following:

Criteria	**Self-monitoring requirements**
2. Waste used as input for the recovery operation	
2.1 Hazardous waste, bio-waste, mixed municipal waste, health care waste, and used products of personal hygiene shall not be used as input.	Acceptance control of all paper-containing waste received by visual inspection and of the accompanying documentation shall be carried out by qualified staff which is trained on how to recognise paper-containing input that does not fulfil the criteria set out in this section.

3.3. Requirements on treatment processes and techniques

The purpose of introducing requirements on processes and techniques is to check indirectly product quality.

Apart from paper which is reused (before collection), waste paper is collected in varying quantities, processed and eventually recycled into the manufacture of paper. Waste paper may need sorting and removal of non-paper components. Some very homogeneous waste paper fractions may just need transport and storage without contact to other waste fractions, while others may need thorough sorting after collection.

Without pre-judging the point in the treatment chain where end-of-waste is reached, the purpose of the introduction of process requirements is to define minimum treatment conditions which are known to in all cases result in quality suitable for EoW. When reaching end-of-waste status, the material must have those minimum necessary treatment processes that make it a suitable direct input material to pulping in the manufacture of paper. The treatment processes must also ensure that transporting, handling, trading and using waste paper takes place without increased environmental and health impact or risks.

The required treatment processes to achieve this differ depending on the waste streams from which the waste paper has originally been obtained. The criteria on processes and techniques can include:

- basic general process requirements that apply in all types of waste/paper streams
- specific process requirements for specific types of waste/paper streams.

Generic requirements that do not prescribe a specific collection scheme, origin, type of operator (municipal/private/local/global) or technology are preferred, since industry and authorities in the waste paper recycling chain should not be prevented from adjusting processes to specific circumstances and from following innovation. For the benefit of simpler EoW criteria, the original proposal specifying that waste paper shall have been collected separately, as a one material flow of waste paper or as a multi-material flow of dry recyclables from which waste paper is subsequently separated, has been removed. This criterion is considered redundant, as only waste paper from this origin will be able to meet the complementary criteria proposed in quality (grading according to EN-643, threshold of non-paper components) and input (origin or contact with municipal refuse or biowaste). Exactly the same argument is used to justify that no requirement is included that waste paper from multi-material origin shall be sorted, as this is ensured by fulfilment of the rest of criteria.

With the same simplification purpose, a proposal has been withdrawn on 'treatment of waste paper contaminated with hazardous components to remove the parts of paper containing these components, to be sent for treatment in a process approved by the competent authority', for two reasons (see also Section 3.1). Firstly, this is a repetition of requirements of application to waste under the WFD, and secondly, it follows from the criteria on input and on quality proposed that EoW material cannot include or be made of hazardous material.

Nevertheless, it should be clear in any case that no dilution with other wastes (i.e. wastes that do not contain recyclable paper) should be allowed for EoW material. As part of this principle, cross-contamination is to be avoided. As the remaining criteria do not provide the means to avoid dilution, it is proposed to maintain a criterion expressing clearly the need of avoiding mixing with other wastes.

There are a range of specific processes and techniques that can be adopted by reprocessors to achieve high quality output. For example, in addition to the choice of equipment installed at sorting plants, key factors affecting the quality of the output include:
- Speed of throughput (e.g. at manual sorting cabins, at mechanical screens)
- Staffing levels within sorting cabins
- Quality management of the input streams (e.g. through communication with the waste producers and collectors)

However, it is the quality of the final output that is key to EoW, not the origin of the waste paper nor how it was treated along the way. If a reprocessor is meeting the quality criteria established by EoW, there shall be no need to prescribe how this is achieved, as this may risk stifling innovation.

The proposed criteria on treatment processes and techniques include:

Criteria	**Self-monitoring requirements**
3. Treatment processes and techniques	
3.1 Waste paper streams used as input shall, once received by the producer or importer, be kept permanently separate from the contact with any other waste, including other waste paper grades. **3.2** All treatments needed to prepare the waste paper for direct input to pulping in the manufacture of paper products, such as sorting, separating, cleaning, or grading, and except de-baling, shall have been completed.	

3.4. Requirements on the provision of information

Requirements on the provision of information are a complementary element of end-of-waste criteria. The criteria have to minimise any onerous administrative load, recognising when current practice is competent in providing a valuable material for recycling, respecting existing legislation, and protecting health and the environment.

Criteria on e.g. labelling of a consignment are only needed in specific cases. One such specific case is to support the limitation of scope of application of the criteria to a specific purpose, pursuing fulfilment of condition (a) of Art 6. in the WFD ("(a) the substance or object is commonly used for a specific purpose").

In the case of waste paper, and as explained in detail in the scope definition in Chapter 1, the only specific purpose commonly used for waste paper is the recycling of fibres, i.e. the manufacturing of paper.

In order to ensure a correct application of the limited scope of use of waste paper, additional requirements are necessary as part of EoW criteria. The purpose of the requirements is to minimise the risk that waste paper that has ceased to be waste is diverted to uses different from manufacturing of paper, be it within or outside the EU. However, there is no jurisdiction to control the uses outside the EU. In this sense, only an adequately designed constellation of criteria ensuring quality, input and treatment can warrant that end-of-waste paper is only attractive for the recycling market, and in all likelihood, it will be used in a papermill. In this sense, it has similar conditions and risks as for ordinary commodities.

Different options are possible for achieving this, some more explicit, some more implicit, some more burdensome and administrative, some more agile. The options are not mutually exclusive.

One of the options discussed is that producers provide evidence that waste paper is destined directly to the manufacturing of paper, e.g. through a contract with a paper mill. Most experts of the technical working group agreed that this is a reasonable requirement. However, some experts argue that such documentation makes EoW paperwork equivalent to the current requirements under Green List waste shipments in the Waste Shipment Regulation.

Another option discussed is that the operator in the waste paper chain is part of a traceability register, by which the producer and subsequent holders of waste paper that has ceased to be waste would be required to keep register of the previous and next holder of the consignment in the supply chain. As only these two steps are registered, confidentiality of operations is safeguarded. By being part of a register, operators commit to make this information available to competent authorities or auditors upon request. A system is currently in place in the paper industry: "*Recovered Paper Identification System*" developed by CEPI, FEAD and ERPA. This system is intended for the purpose of traceability up the supply chain, but could likewise work down the supply chain. Traceability is suggested for the consignment, and not to the individual bales. Many experts see this as a possible optional requirement, but most opposed to include it as a compulsory element of EoW.

Another option discussed is to require compulsory labelling on the end-of-waste consignment, once it has passed all end-of-waste requirements and its exclusive intended use is the manufacture of paper. Labelling is not meant as a physical attachment to the bales, but as a visible remark in the Statement of Conformity. The labelling is meant as a supplementary highlight of the scope of the EoW criteria stated in the recitals of the Regulation.

Most experts have agreed in introducing a requirement on labelling. This requirement does not directly ensure that waste paper is destined to the manufacturing of paper, but no other of the requirements proposed would provide a warranty on this, as all of them can be misused if this is the intention. However, ignoring the labelling is ignoring the scope of the Regulation. If paper material labelled as EoW is not intended for papermaking, it becomes waste, and the consignment becomes an illegal shipment of waste.

It is proposed that the requirement on the provision of information requires compulsory labelling on the intended exclusive use of the waste paper. The labelling is only for the purpose of highlighting the scope of the EoW criteria Regulation, which could be included in the recitals. This labelling is the only option of the

proposed that has been judged acceptable by all experts, it does not impose additional burden, and is deemed proportional to the risk of infringement in light of the strictness of the rest of criteria. The non-paper component threshold proposed is only achievable for waste paper that was directly of high quality or has gone through sorting, restricting the market for the end-of-waste paper to buyers willing to pay for this quality in of paper because of the high content of fibre of suitable quality for papermaking. EoW paper of this quality poses no environmental or health risk. Historic series of market conditions and prognosis of future scenarios (see Chapter 4) indicate that the risk that waste paper of this quality is diverted for other purposes is negligible. If after all this happened, the (EU) holder that uses EoW paper for other purposes would be made liable of infringement of the Regulation.

Labelling of multi-material origin

Some experts of the technical working group support highlighting a requirement, also present in EN-643, of labelling specifically waste paper form multi-material systems. Some stakeholders, on the other hand, suggest that the reference to the origin of the material is not needed at all. The argument in favour of it is that the knowledge of a multi-material origin is found necessary by some papermills and reprocessors to be aware of a higher risk of non-paper component content and cross-contamination of the material, and better handle it as part of their quality management systems. This knowledge is complementary to the total non-paper component content, and lets the buyer know that there is a higher probability of presence of certain types of non-paper materials such as glass fines, which are detrimental to papermills. Labelling facilitates also legal compliance in the manufacture of paper in the cases where non-paper component materials often found in waste paper from multi-material sources are not allowed, e.g. paper products to be in contact with food. As with the intended purpose, labelling is here not meant as physical attachment of a paper to the bales, but the inclusion of additional short text in the (digital) Statement of Conformity in a consignment.

Labelling is seen as a soft, low burden criterion, and therefore it is proposed as a suitable proportionate instrument to tackle the risk of cross-contamination content at paper mills, as well as a means of indirectly raising awareness to the additional sampling frequency expected in these types of consignments.

Some stakeholders have requested that the labelling includes a definition of what is meant by multi-material origin. However, as the definition would be provided in the recitals of the Regulation, this is not judged essential. If judged necessary, the definitions of "mono-material origin" and "multi-material origin" can be included in the statement of conformity.

Some stakeholders have suggested adding, in the part concerning information requirements and statement of conformity, a reference to the EU legislation on the Aarhus Convention, notably to Directive 2003/4/EC, but without being more precise on which specific item of the Directive.

Some stakeholders have suggest to label as not suitable material for the production of direct or indirect food packaging material, e.g. newsprint (Grade 2.01), remittent newsprint (Grade 2.02) and deinking ware (Grade 1.11). It is argued that these paper grades may be highly contaminated with mineral oil saturated hydrocarbons (MOSH) and mineral oil aromatic hydrocarbons (MOAH) from newsprint inks. MOSH and MOAH are able to migrate into the food and may display hazardous properties. However, grading according to EN-643 is required, therefore producers of food packaging material should be able, as they currently do with waste paper under waste law, to identify the suitable sources. The presented requirement is thus a matter that can be established in commercial agreements, and does not need be part of EoW criteria.

The labelling of the intended use is seen as an additional element to the inclusion of a statement about this scope restriction in the enacting provisions of a Regulation, that is, a legal condition.

The proposed criteria on requirements on the provision of information are as follows:

REQUIREMENTS ON THE PROVISION OF INFORMATION[62]

[62] NOTE: Attention shall be given in the formulation of the legal text to the language in which the labelling statements have to be included.

Waste paper that has ceased to be waste is only intended for use in the manufacture of paper. Waste paper consignments shall be specifically labelled with a statement on this intended use.

The statement of conformity of the consignment shall include a section with the statement: "INTENDED EXCLUSIVELY FOR THE MANUFACTURE OF PAPER."

Waste paper consignments that stem from multi-material collection systems shall bear a label indicating the multi-material origin.

A multi-material collection system is a system for deliberate collection of two or more recyclable materials together, e.g. plastic, metal, paper and glass. Normally, Materials are later sorted into mono-material streams at a dedicated sorting plant. Examples of widespread multi-material systems are separate packaging collection systems, and comingled collection systems.

The statement of conformity of a consignment that stems from a multi-material (e.g. comingled) collection system shall include a section with the statement: "MULTI-MATERIAL ORIGIN".

3.5. Requirements on quality assurance procedures (quality management)

Quality assurance is an element of end-of-waste criteria of importance because it is needed to establish confidence in the end-of-waste status. The technical working group has expressed very strong support for making quality assurance requirements part of the end-of-waste criteria.

The acceptance of input materials, the required processing and the assessment of compliance with waste paper requirements shall have been carried out according to good industrial practice regarding quality control procedures.

In this context, quality assurance is needed to create confidence in the quality control on the waste paper undertaken by its owner, and reliability on the end-of-waste criteria that distinguish consignments meeting EoW criteria from consignments that have not applied for or do not meet EoW criteria. The owner of the material applying the end-of-waste status will have to have implemented and run a quality assurance system to be able to demonstrate compliance with all the end-of-waste criteria, and use this as documentation when the material is shipped.

The quantitative limit under EoW criteria is only on non-paper components content. It cannot be checked using standardised testing methods, but it is relatively straightforward to check compliance through sampling and analysis using accessible equipment.

Both in the qualitative and quantitative EoW criteria that refer to procedures and process controls, it is considered essential that there is a quality management system in place which explicitly covers the key areas of operation where compliance with end-of-waste criteria has to be demonstrated.

One of the possible options to demonstrate compliance is having implemented and run an internationally recognised and externally verified quality management system such as ISO 9001, or equivalent. External verification is a compulsory element of these, and should assess if the quality management system is effective and suitable for the purpose of demonstrating compliance with the end-of-waste criteria.

A suitable quality management system for waste paper is expected to include:

- acceptance of input materials;
- monitoring of processes to ensure they are effective at all times;

- procedures for monitoring product quality (including sampling and analysis) that are adjusted to the process and product specifics according to good practice;
- actively soliciting feedback from customers in order to confirm compliance with product quality;
- record keeping of main quality control parameters;
- measures for review and improvement of the quality management system;
- training of staff.

For the competent waste authority, it must be able to commission an independent second party audit of the implemented quality management system to satisfy itself that the system is suitable for the purpose of demonstrating compliance with end-of-waste criteria.

In respect of the frequency of monitoring, the appropriate frequency for each parameter should be established by consideration of the following factors:
- the pattern of variability, e.g. as shown by historical results;
- the inherent risk of variability in the quality of waste used as input to the recovery operation and any subsequent processing;
- the inherent precision of the method used to monitor the parameter; and
- the proximity of actual results to the limit of compliance with the relevant end-of-waste condition.

Frequency of monitoring includes both the number of times a parameter is monitored over any given time period and the duration of each monitoring event so that it is a representative sample of the total. In the absence of historical results for any relevant parameter, it is good monitoring practice to carry out an intensive monitoring campaign over a short period (e.g. a month or a few months) in order to characterise the material stream and provide a basis for determining an appropriate longer term monitoring frequency.

The result of the monitoring frequency determination should provide a stated statistical confidence (often 95% confidence level is used) in the ultimate set of monitoring results. The process of determining monitoring frequencies should be documented as part of the overall quality assurance scheme and as such should be available for auditing. The detail on the verification, auditing or inspection of the quality assurance system can follow different national approaches.

The Commission adopted a reference document in July 2003 entitled "General Principles of Monitoring" which was developed under the provisions of the IPPC Directive but which remains a relevant reference for the determination of appropriate monitoring frequencies in this respect. It is available to download from the web site at:
http://eippcb.jrc.es/reference/_download.cfm?technical working group=mon&file=mon_bref_0703.pdf.

A number of guideline documents addressing quality control have been issued in the paper sector, including:

- *Recovered paper quality control guidelines* (CEPI and ERPA)
- *Best practices for the global inspection of recovered paper* (CEPI)
- *INGEDE methods 7,8 and 14.*

The recommendations in these documents are meant to improve the mutual understanding between producers and buyers of waste paper, and the general conditions of their contracts. These recommendations include additional elements not mentioned above such as:

- Special quality specifications besides reference to EN-643 grades should be agreed between buyer and supplier
- Reciprocity in communication of quality results is recommended between buyer and supplier
- Quality controllers should be independent from the commercial department.
- Conditions of reject and limits of ownership should be agreed between buyer and supplier

Most elements of the mentioned guidelines are not included in the end-of-waste criteria. The reason is that while these elements are useful in transactions, they are to be applied under equal conditions to consignments of waste or of end-of-waste.
Additionally, the UK's Confederation of Paper Industries has issued an *Export Code of Practice for the recovered paper industry*. The document provides key requirements of managing and controlling the output quality of waste (*recovered [sic]*) paper, and is designed to give competent authorities confidence that waste paper is not leaving UK facilities for shipment overseas in breach of the Waste Shipment Regulation, leading to illegal dumping in developing countries. It is a voluntary code, and it is up to each individual company to decide whether to subscribe to the code. It includes elements not included in the proposed requirements, such as:

- Auditing protocol;
- Key training requirements; and
- Commitment to supplier engagement.

The requirements on quality management proposed are:

QUALITY MANAGEMENT

1. The producer shall implement a quality management system suitable to demonstrate compliance with the EoW criteria.

2. The quality management system shall include a set of documented procedures concerning each of the following aspects:

   (a) monitoring of the quality of waste paper resulting from the recovery operation (including sampling and analysis);

   (b) monitoring of the treatment processes and techniques;

   (c) acceptance control of waste used as input for the recovery operation;

   (d) feedback from customers concerning the product quality;

   (e) record keeping of the results of monitoring conducted under points (a) to (d);

   (f) review and improvement of the quality management system;

   (g) training of staff.

   The quality management system shall also prescribe the specific monitoring requirements set out for each criterion.

3. Where any of the treatments is carried out by a prior holder, the producer shall ensure that the supplier implements a quality management system which complies with these quality management requirements.

4. The importer shall require his suppliers to implement a quality management system which complies with these quality management requirements.

5. A conformity assessment body as defined in Regulation (EC) No 765/2008 or an environmental verifier as defined in Regulation (EC) No 1221/2009 shall verify that the quality management system complies with these quality management requirements.

6. The verification should be renewed in the event of any change at least on a three-yearly basis.

7.	The producer shall give competent authorities access to the quality management system upon request.

Notes:
Some stakeholders have additionally suggested that the time period of record-keeping (point 2.e) should be consistent with the auditing intervals (point 6 under Quality management) and not be shorter than the suggested audit intervals.
Some stakeholders propose that the possibility for making an audit on the request of a downstream user should be included.

3.6. Application of end-of-waste criteria

For the application of end-of-waste criteria laid out above it is understood that a consignment of waste paper ceases to be waste when the producer of the paper certifies that all of the end-of-waste criteria have been met.

It is proposed to formulate the restriction of the intended use to papermaking as a legal condition in the enacting provisions of a Regulation.

It is understood that waste paper that has ceased to be waste can become waste again if it is discarded and not used for the intended purpose, and therefore fall again under waste law. This interpretation does not need be specifically stated in the EoW criteria, as it applies by default.

It is proposed that the application to EoW from a producer or importer refers to a statement of conformity, which the producer or the importer shall issue for each consignment of waste paper, see draft form below. The producer or the importer shall transmit the statement of conformity to the next holder of the consignment. They shall retain a copy of the statement of conformity for at least one year after its date of issue and shall make it available to competent authorities upon request. The statement of conformity may be issued as an electronic document.

Statement of Conformity with the end-of-waste criteria

1.	Producer of the waste paper: Name: Address Contact person Telephone.: Fax: E-mail:
2.	a) The grade of waste paper in accordance with standard EN-643: b) The content of non-paper components, in percentage points of air dry weight:

	c) Origin of the material (tick where appropriate) c.1) MULTI-MATERIAL ORIGIN c.2) MONO-MATERIAL ORIGIN
3.	Quantity of the consignment in kg.
4.	The consignment complies with the specifications of standard EN-643.
5.	This consignment meets the criteria referred to in this Regulation
6.	The producer of the waste paper applies a quality management system complying with the requirements of this Regulation, and which has been verified by an accredited verifier (this does not apply when waste paper which has ceased to be waste is imported into the customs territory of the Union)
7.	THE MATERIAL IN THIS CONSIGNMENT IS INTENDED EXCLUSIVELY FOR THE MANUFACTURE OF PAPER.
8.	Declaration of the producer of the waste paper: I certify that the above information is complete and correct and to my best knowledge: Name: Date: Signature:

Note1: Items 2(a), 2(c) and 4 are a highlight of key information issues already required under item 5, which refers to quality criterion no. 1.1. on the grading of the consignment following EN-643, in which these items are included. They are a reiteration, but most experts have supported to include these elements as a part of the criteria.

Note 2: Some industrial stakeholders (FEAD, BIR) have requested that the terms "multi-material origin" and "mono-material origin" under p.2(c) are explicitly defined in the statement of conformity, as they see the statement will have a life somehow independent from the Regulation, which would likely include these definitions in the recitals. The definitions proposed are the following:
Multi-material origin means that waste paper originates from a collection system for deliberate collection of two or more recyclable materials together, e.g. plastic, metal, paper and glass. Materials are later sorted into mono-material streams at a dedicated sorting plant.
Mono-material origin means that waste paper originates from a collection system designed for the collection separately of only one recyclable material, e.g. plastic, metal, paper or glass

Note 3:

Some stakeholders suggest that Point 2(b) bears a clarification note where it states that it will not be possible to state the content of non-paper components for every consignment of waste paper. The Quality Management Systems and risk-based monitoring will provide a level of confidence that the consignment is below the 1.5% threshold, but will not provide an actual measurement for every consignment. The statement of conformity would in that case clarify that the results of the risk-based monitoring demonstrate compliance with the 1.5% limit on non-paper components.

This proposal has not been included, as (1) compliance with the limits is required in all cases, and (2) the self-monitoring requirements include the essential demands to sampling.

4. Description of Impacts

The introduction of end-of-waste criteria is expected to support recycling markets by creating legal certainty and a level playing field, as well as removing unnecessary administrative burden. This section outlines key impacts on the environment, on markets, and on existing legislation, of the implementation of end-of-waste criteria.

A summary table of the impacts is provided at the end of the chapter.

4.1. Environment

Air emissions, odours, dust, noise, fire risks, health impacts

Within the EU, the treatment of waste paper will remain under waste regulation, as for any facility that handles waste input. Thus, the specific emissions, dust or noise generated during the treatment of waste containing paper will not be changed by the implementation of end-of-waste criteria. The environmental and health impacts of paper manufacturing are described under IPPC permits. The composition of these rejects and the point of the recycling chain in which they are generated may change with a shift to EoW paper input, as it is likely that an increasing amount of rejects of non-paper components (metals, plastics, etc) has to be disposed of by the reprocessing plants, instead of the paper mills. This would improve health and safety down the waste paper chain, and may affect the permits of both reprocessors and paper mills.

Risks related to transport and storage

Storage and transport of end-of-waste paper will no longer be covered by waste regulatory controls. Theoretically, this could imply an increased risk of impact to the environment in case end-of-waste paper had properties needing control only provided by waste regulation. However, normal good practice of transport and storage seem to be appropriate to control the type of risks of end-of-waste paper storage, namely those of fire, biodegradation under storage in too wet conditions, and control of dust and nuisance of paper blown away with the wind. These impacts are currently controlled in many reprocessing plants by indoor storage, separation screens and walls, fire extinction piping, and regular cleaning. In practice it can be expected that end-of-waste paper will, as a product, be stored in most cases under the same conditions as it used to as waste.

In the proposed EoW criteria, no special provisions for health and environmental protection are introduced except: (1) the exclusion of a number of input materials, such as hazardous materials, food waste, or health care waste; and (2) the potential exclusion of some types of waste paper layered with non-paper material. The criteria proposed are considered sufficient to reduce the health and environment risks from cross-contamination to a minimum, and thereby the risk of disamenities like odours, vermin attraction, or leaching, as if they were under waste law. Among other effects, this will have an impact on some paper grades that have an origin in multi-material collection systems, and are therefore more exposed to cross-contamination. If these waste paper grades do not meet the criteria, then it is understood that they cannot fulfil - in all conditions of use of the waste paper as a product - the fourth condition of Art.6 of the WFD, which requires that the use of the substance or object does not lead to overall adverse environmental or human health impacts (compared to its use under waste law).

Impacts outside the EU

It is unlikely that facilitated export of end-of-waste paper outside the EU would have any substantial effects on increased emissions outside the EU. It may be of concern that emissions (air, water, waste generation) of paper production outside the EU may be larger than in the EU. However, if changing with EoW, these emissions would decrease and not increase, as non-paper component content is on average lower in end-of-waste consignments than in waste consignments.

End-of-waste will likely imply a shift of reject waste disposal, but for the better: by more systematically controlling sorting and cleaning to meet EoW material quality criteria, there would be a reduced export of non-paper components in waste paper, as exported end-of-waste paper will be on average less polluted than

waste paper exported today for production outside the EU. Rejects will thus be treated within the EU, under EU waste law, and not under the waste law of the destination countries. This would imply additionally the avoidance of cases of camouflaged waste export, export for cheap labour sorting purposes, and the avoidance of the unknown disposal of the non-paper fraction in the destination country. Marginal energy savings may also result by not unnecessarily transporting for long distances the unusable materials in waste paper.

4.2. Markets

The following potential economic and market impacts may be expected:

- Avoidance of costs related to shipment of waste;
- Avoidance of costs of handling the waste paper in terms of permits and licenses;
- Costs of additional sorting and quality control of waste paper;
- Coexistence of waste and non-waste markets, and non-papermaking markets.
- Impacts on countries with collection of beverage cartons together with other paper;
- Long-term availability and strategy of the European paper industry;
- Price adjustments;

Costs related to shipment of waste

The waste status of waste paper affects its exportability by increasing the administrative and economic burdens. The total costs related to international shipment are related to the following factors (BIR, 2010):

- Requirement to obtain certain information from overseas (non-EU) re-processors to satisfy 'broad equivalence' obligations set out in the Packaging Directive, and Waste Shipments Regulation. With 'end-of-waste' status, it would be possible to produce the necessary evidence based on the end-of-waste criteria concept.

- Notification and insurance costs on financial guarantees for waste shipments sent to countries where pre-notification is required (including certain 'green list' shipments) under the Waste Shipments Regulation. Each notification requires a financial guarantee, except to countries under treaty of accession arrangements. This is covered by financial institutions at certain costs, and also means a less liquidity for the waste paper operators. Because of this there is a limit to the number of notifications a company can handle or absorb. In other words, there is an artificial (trade) barrier and companies can not sell to all potential customers after their financial limit has been reached.

- The shipment of Green Listed waste to EU Member States in a transitional period does not require a financial guarantee (insurance). However administrative fees for notification might be high and vary from country to country. End-of-waste would facilitate free trade of waste paper that meets the set end-of-waste criteria in Latvia up to 31 December 2010; Poland up to 31 December 2012; Slovakia up to 31 December 2011; Bulgaria up to 31 December 2014; and Romania up to 31 December 2015.

- Administration costs for maintaining Annex VII Waste Shipments Regulation tracking forms and domestic waste movement forms. In addition to the direct administration costs associated with form filling, there is an issue of having to supply commercially sensitive data. Customers outside the EU jurisdiction are not willing to have their commercial transactions recorded and made available to public authorities. Therefore they turn to non-EU suppliers.

- Loss of business where customers fail to provide appropriate information

Costs of handling the waste paper in terms of permits and licenses

The situation for waste collectors, transporters and reprocessors regarding permits or licenses will not change. Some traders and transporters may decide to trade only waste paper which has ceased to be waste, and would not need any waste license.

There is no additional cost expected for waste paper material that does not qualify for end of waste criteria. Collection and reprocessing can continue as usual under waste law, and the use of non-qualifying waste paper grades by paper mills will not cease, as the qualities of the waste paper that currently is recycled will not disappear with the introduction of end-of-waste criteria.

As part of an authorisation to treat waste, a waste paper company may have to complete the following administration paperwork every year:

- An annual report (company-specific reporting of all transactions and EWC code-specific reporting of all transactions). This usually requires administration time of 5 person months / year).
- Monthly reports of incoming and outgoing materials.
- Record books.
- Special activity license for the yard, for transport for processing (for the yard approval as an example the license renewal is every 10 years, for example. Procedure takes at least 6 months to 1 year. The costs of the reports are substantial.
- Environmental impacts assessment of the waste paper yard activity if handling over 5 tonnes/day.
- Environmental responsibility insurance.
- Waste transport authorization (There is a restricted market of carriers, transporters of waste paper classified as waste).

These requirements would be relieved if a company only deals with end-of-waste. End-of-waste would in these cases release some resources, but it adds other requirements, as EoW consignments will need documentation on fulfilment of the EoW criteria. However, this documentation is not much different from the type of information that follows the trade of any commodity, and is a warranty of the consignment having passed a quality check, and the record of its trade. The burden is thus of a different nature: under waste law it is meant to trace the material and highlight its waste nature and the need of additional environmental and health precautions, whereas as non-waste the burden is the ordinary quality statement and documentation of a commodity.

Costs of additional sorting and quality control of waste paper

This is one of the major economic impacts identified. The paper industry has claimed for many years that waste paper is a valuable raw material, and has pushed for acknowledgement of the product qualities of waste paper. However, in the waste paper sector these demands have not been balanced so far by a correspondingly quantitative quality control of output material from reprocessors, compared to what is current practice in other recyclable markets such as glass/cullet. EoW will enable and require such balance, ensuring that waste paper that ceases to be waste follows the same practice that is expected from a commodity.

One of the characteristics expected from a product is a defined quality. EoW criteria requiring quantitative measurements have been kept to a minimum in order to avoid unnecessary costs. However, it was acknowledged by the technical working group that the threshold on non-paper components was the quantitative quality criterion most needed. The use of this criterion as the cornerstone of the EoW criteria is in line with current practice, as this parameter is used in the definition of the quality of paper, e.g. the definition of grade-by-grade tolerance levels of non-paper components both in IRSI's specifications and in the update of EN-643. By establishing this strong criterion, other EoW criteria become redundant, e.g. an input criteria requiring that the material is composed mainly of paper: by fulfilling that waste paper is graded according to EN-643 and respecting the non-paper component threshold, one can be sure that the material delivered is mainly paper fibre.

The introduction of a threshold on non-paper components will result in an overall increase of the sampling effort needed to check whether the content limit is met or not, compared to current levels, and in a shift from measuring this parameter only at the entry to papermills to a re-distribution of the sampling effort along the waste paper supply chain, e.g. at the output from reprocessors. As mentioned above, such distribution of sampling is commonplace in the handling of other recyclates. The overall increase in sampling is expected because this is the only means of documenting the non-paper component content. However, the frequency of measurement will vary. It can be expected that in a risk-based approach based on robust statistics, the high quality grades will need very sparse quantitative control in addition to a

systematic visual inspection ("fast track" concept), and the mixed grades from e.g. multi-material collection will need very frequent sampling. The exact value of the threshold has an influence on the magnitude of this effort, as discussed in Section 3.1, and this has been one of the most important arguments considered for proposing 1.5% as the non-paper component content threshold.

Facilities that based their quality management on visual inspection exclusively will have to invest in equipment for measurement of non-paper components. However, the equipment can be as simple as a sorting table, some trays, a scale, and a microwave to obtain dry air conditions. Larger expenses can be expected in:

1) the start-up phase, in getting familiar with the grades that can qualify for EoW, and acquiring the expertise about of the sampling frequency needed for each grade.

2) the operation phase, in the time required for undertaking the measurements and storing the data.

Quality control of output is commonplace in the reprocessing of other recyclables with less specific value such as glass/cullet (30-50 EUR/tonne), suggesting that the uptake of these practices is by and large not a matter of costs but of change of practice. Companies would have to incorporate the new EoW procedures into existing quality management protocols, which shall be regularly audited by a third party.

In risk-based sampling, many approaches are acceptable if they contribute to ensure quality. For instance, it would be acceptable to use quantitative feedback from customers as part of a sampling plan, that is, sampling does not need to be undertaken exclusively before the shipment of a consignment: consignments part of long-term contracts may benefit from sparser frequency needs, and control may use data taken upon arrival at the papermill, if the same material of the same grade and the same treatment is delivered over a long period of time. However, it shall be made clear that the entity that has the burden of proof and shall guarantee compliance with the criteria is the producer/importer. As long as the quality of the consignment and fulfilment of the EoW criteria can be guaranteed and documented to the buyer and inspectors through the EoW Statement of Conformity, and that the method used to ensure this quality is documented to third party auditing, it is up to the holder of EoW paper to decide which procedure to use. This is of course not the case for ad-hoc shipments not part of long-term contracts, as sampling will be needed on the consignment before dispatch.

These new playing rules for shipments candidate to EoW would require additional communication efforts between suppliers and buyers, as better communication and exchange of sampling results between reprocessors and paper mills can significantly reduce the sampling effort required on both sides.

Coexistence and share of markets

The entering into force of an EoW criteria Regulation will likely result in a new option within the market of waste paper. Waste status will remain for a part of the waste paper market. Firstly, as explained in detail in the scope definition, all other uses of waste paper than papermaking will remain under waste legislation, until a decision is made on the appropriateness of preparing additional EoW criteria for other uses. Secondly, the waste paper market for papermaking will have a new option, both within the EU and outside the EU. EoW paper, because of its demonstrated quality, will in its own right acquire the benefits of a product in terms of trade and image. Waste paper that remains waste will continue to be a valuable material for papermaking. Both market options will find an equilibrium point and coexist. The exact point of equilibrium and uptake of the new option can not be predicted. Decisions will have to be made by individual reprocessors and mills, weighting the advantages and disadvantages for them of both options.

Coexistence will also be observed on trade. On the one hand, paper that has ceased to be waste will be easier to export out of the EU. On the other hand, the EU demand of paper that has ceased to be waste will also be higher, as higher quality material generating less rejects is likely to be more demanded in the area where the costs for paper mills of disposal of rejects are higher, which is currently the case of the EU compared to e.g. Asia. It is difficult to forecast the share of EoW material in the domestic market and in exports outside the EU when equilibrium is reached. It may vary depending on how strong is the EU's demand for waste paper vis-à-vis the demand from outside the EU.

As discussed in Section 3.1, the EoW criteria have been proposed with the aim of encompassing the main flows of waste paper that are currently used and perceived by the industry as a valuable raw material, while respecting the conditions of Art.6 of the WFD. In the absence of a unique solution that fits all demands, the proposed criteria are the result of a compromise and the principle of proportionality, addressing with priority the major flows.

The small flows of waste paper sold currently for uses different from papermaking have been excluded from the scope of the end-of-waste criteria presented in this study. These uses represent currently less than 10% of the total waste paper flows, and are almost exclusively composed of waste paper grades of the lowest quality, unfit for papermaking. No use different from EoW has been found that requires high quality waste paper, EoW shall not affect the current availability of waste paper for these markets (composting, insulation and filling, animal bedding, energy) , which in any case would take place under waste legislation. Should these uses require higher quality waste paper, there should be no barrier for having access to end-of-waste paper. The only consequence for the non-papermaking users is that EoW status is not any longer maintained. End-of-waste paper would return to its waste status, and its use be regulated by waste law.

Impacts on countries with collection of beverage cartons together with other paper

Several experts of the Technical Working Group have advocated for the exclusion of waste paper grades that have a high content of materials different from paper, most notably layered multi-material waste paper such as beverage cartons (25% non-paper), or plastic-layered kraft sacks (ca. 5% non-paper, c.f. Section 2.6. on environmental and health issues). The main argument behind this is that the non-paper material is currently not recycled, and has to be treated as waste. The inherent environmental risk of inappropriate management is higher than for other paper grades. In addition, the amounts of these grades are very small in the overall picture of waste paper in the EU, e.g. beverage cartons represent ca. 0.5% of the total flow of 60 Million tonnes yearly in the EU, and PE-layered sacks ca. 2% in Spain, and 0.3% in Germany. It is considered disproportionate in the current EoW criteria to design additional criteria that would add complexity and would only fit this minor flow of multi-layered materials.

Conversely, beverage carton producers claim that exclusion from the currently proposed EoW criteria would result in market distortion, derived from an alleged obligation of modifying existing collection systems in the (few) countries or regions where beverage cartons are currently collected together with other waste streams, e.g. Italy, Finland, or Sweden. To estimate the derived costs, Tetra Pack has commissioned a cost-benefit study (Prognos, 2010).

This study by Prognos displays the relative additional costs of a number of scenarios, compared to current practice. However, there are three severe shortcomings in the analysis: Firstly, the estimated scenarios are all based on the incorrect assumption that a change in the existing systems is compulsory. As explained in the TWG workshops, and in this report (including earlier versions), EoW is a facultative mechanism. The study by Prognos does not present any justification about why one would be willing to change existing, well-functioning systems.

Secondly, the results present relative differences between scenarios, but no indication of the absolute value of benefits and costs of the scenarios that could help interpreting the relative magnitude of the changes. It does therefore not allow a quantification of the default scenario of introducing EoW to waste paper while keeping business-as-usual conditions for the fractions containing beverage cartons, as is current practice[63]. The study does not include either the also basic scenario where beverage cartons were part of EoW, so one could see a quantification of the potential benefits of this option. Without the mentioned basic elements, the study is very incomplete, as the scenarios included in the study do not reflect realistically the potential economic effects of EoW. The results presented are thus interesting from a theoretical standpoint, but are of limited use for the identification of realistic impacts.

[63] The quantification of the presented scenarios is described as "compared to the status quo", which one must assume is the business-as-usual scenario under waste law. But no absolute calculations are shown; only the net difference comparison between scenarios is presented. Assuming these calculations are correct (c.f. mentioned shortcomings), and since all scenarios display additional cost compared to the reference scenario, one must infer that the reference scenario must be the least costly, a deduction that would confirm the hypothesis that the current scenario under waste law is the best performing, and the one that should be kept.

Finally, in addition to the mentioned shortcomings in scope and content, the hypothetical scenarios displayed present fundamental methodological biases. The most important is the imbalance in the estimation of costs and benefits. The report is presented as a cost-benefit analysis, but it omits the evaluation of the potential benefits of the system as a whole, to society, presenting calculations that essentially only comprise the costs for the beverage carton industry and the collection system operators[64].

With the current formulation of EoW criteria as a facultative instrument, the countries and regions where liquid beverage packaging is collected together with other dry recyclables, or other household waste paper (sometimes with newsprint, sometimes without) can maintain their current collection systems. The content of beverage packaging to other waste paper varies largely[65], from 0.6% (Italy) to 16% (Sweden), mainly depending on the newsprint content in the mix. The EN-643 grade resulting from such collection can in both cases be 5.02, but other options are possible, e.g. 5.01, and the market price will depend on the type of waste paper content.

If the mentioned regions or countries find a benefit in separating beverage cartons or other paper from these mixed streams in order to pursue EoW for the cleaner fractions, they can opt to do so. The decision will normally be made upon a holistic assessment of the benefits and drawbacks of the alternatives, compared to maintaining the default scenario. As discussed above, the degree of uptake of EoW is difficult to foresee. In some cases such as Italy, because of the very low content of beverage cartons compared to the total collected paper (0.6%), EoW classification could still be possible for the stream as it is, because the non-paper component threshold proposed in EoW would not be trespassed.

Countries where some paper streams contain higher amounts of beverage cartons may choose between remaining under waste legislation, or if the overall benefits of EoW fit, undertake further separation or other changes in the system. EoW includes no requirement on waste paper that concerns the efforts made or to be made in these countries to increase collection rates of beverage cartons under the waste status, as it has successfully been done in the past. Beverage cartons contain indeed 75% recyclable material, and it is desirable that the efforts to recycle the paper content of this stream should continue.

Long-term availability and strategy of the European paper industry

Standards on high-quality end-of-waste materials will enable materials reclaimed from waste to better compete with primary raw materials. Currently, this happens with some identified imperfections.

A quantitative assessment of the impact of end-of-waste criteria on exports to third countries is not feasible with the data available. However, it is not to be expected that releasing certain waste paper from the waste regime would lead to additional exports at a scale which could threaten the availability of these secondary raw materials on the EU markets. Should availability be of concern, the market instruments of trade policy would enter into action (custom tariffs, taxes, subsidies) regardless of the waste status of waste paper. Such trade policy instruments are of much larger magnitude and impact than the market effects of EoW (e.g. Chinese 15% tariff on the exports of metal scrap).

The historical and forecasted trends of paper consumption and waste paper collection show a constant increase, see Figure 12.

[64] For example, a scenario in Finland is presented, where the current collection of beverage cartons in households together with other fibre packaging is changed and these two are collected independently. The results of the calculation are net costs of 5M€/yr, that omit any potential benefit of higher value of obtaining cleaner streams. Provided there was a rationale for the interest in analysing this scenario, and the omitted benefits are incorporated, why would a region or country choose such system if no legislation imposes it, and no benefits are expected? It is good practice that LCA and CBA studies intended for public disclosure are externally reviewed by independent third parties, and that the results of the review are included in the study, for transparency. It is not known whether the study by Prognos is or not intended for public disclosure, but it does not include a third party review.

[65] Schuetz et al., 2010

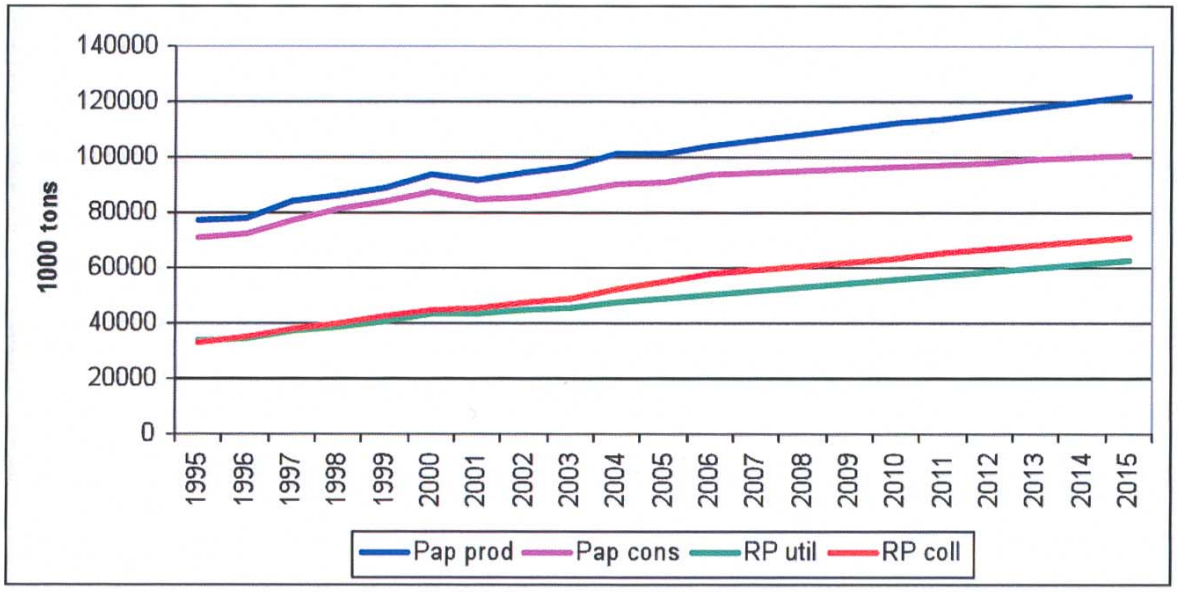


Figure 12. Forecast of paper production and consumption, and waste paper collection and utilisation in Europe. Source: Ervasti, 2008

Increasing amounts of paper waste are being generated in the EU, following the efforts undertaken to tap all possible waste paper sources. In the last decades, the amounts of waste paper generated in the EU have been consistently higher than the amounts used by EU industries, leading to increasing exports, which as of 2009 amounted to about 10% of waste paper generation. As described in the exports section in Chapter 2 and depicted in Figure 9, the main destination of EU waste paper exports is China. The forecasts of waste paper use in China indicate also a progressive growth (Figure 13).

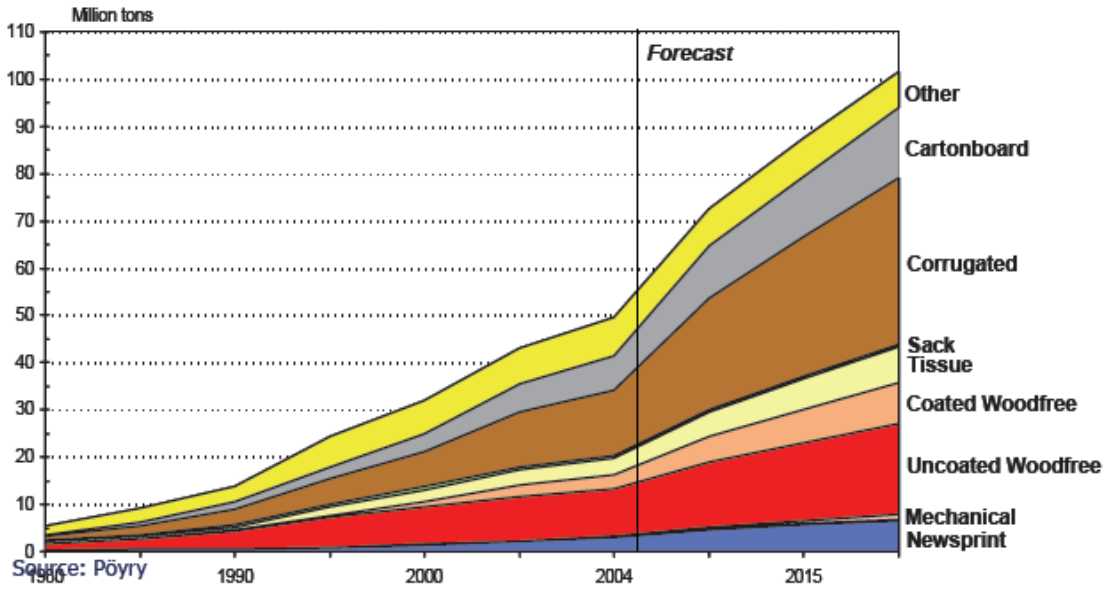


Figure 13. Chinese paper production, past and forecasted. Source: Dixon Smith, 2009.

When waste paper is exported, one also exports the energy and emission savings of using this resource compared to using raw materials. So far, the trade of embedded savings is some how balanced: waste paper is shipped from the EU to China, but it returns to the EU in the form of good's packaging. With the current collection systems in place in the EU, a large part of this waste paper source is readily collectable and is made available for papermills by reprocessors. At a point, the development of domestic consumption and

collection systems in China should decrease China's current reliance on waste paper imports to maintain the expected growth, as has happened in other developed economies. This may reduce the imports of waste paper to China, but it is to be seen if it also stops the export as packaging, so the equilibrium of net imports of fibre may move. Unless alternative packaging materials are able to substitute paper packaging, it is highly improbable that fibre would become a scarce resource in the EU, as it would continue to flow back to the EU in a recyclable form.

From an EU perspective in the current situation, the international market for waste paper needs to function well, there must be sufficient demand for waste paper, inside or outside the EU, and waste paper prices must remain reasonable and without excessive volatility. A high demand from export markets for waste paper has been in some periods in the past crucial to sustain or further expand the recycling of waste paper generated in the EU, and this is facilitated by EoW. This overseas demand has expanded the reprocessing capacity of the EU, and it is to be seen whether this is for a transitional period or as a permanent status. The international demand conditions may change if China gradually becomes more self-sufficient in waste paper and no other country takes over the international demand pull. As the flow of packaging in Chinese exports would still exist, this scenario may result in a surplus of waste paper in the EU that can be followed by e.g. price decrease, with detrimental effects to the EU's paper reprocessing industry.

Price

Generally speaking, waste paper prices follow paper product prices. Non-EU demand for waste paper is currently about 10% of domestic demand in the EU. It is therefore likely that the domestic EU demand will continue to play the largest role in price setting. EoW paper will fit into this existing market with little disturbance in economic terms, including prices.

Better conditions for exports of waste paper that has ceased to be waste may lead to more investments in reprocessing, such as more protected storage areas for EoW paper to avoid loss of quality, and more quality control and sorting equipment at reprocessing plants (see discussion above). Some of this equipment may increase the use of energy and manpower at reprocessing plants. However, this may lead to a subsequent reduced need of non-paper component separation at paper mills, due to the more systematically checked quality, sorting and characterisation of the input materials received.

It is expected that the supply of high quality waste paper would be stimulated. This may lead to an increase in recycling rates and an image improvement, both of them stimulating collection and recycling. One of the potential side effects of this in the medium and long term could be marginally higher prices of waste paper that has ceased to be waste, compared to waste paper. This possible effect on prices is seen differently by papermills and reprocessors. Reprocessors can expect a price increase signal if they are able to deliver consignments with the added value of being quality-checked as part of a quality management that includes periodical quantitative sampling. The comments received from papermills indicate that they are cautious on their willingness to pay more for a quantitatively-checked material, as this is a very different situation from the past, where systematic quantitative quality control have been undertaken almost exclusively upon receiving waste paper at the mills, and very few reprocessors have sampling programmes.

Prospective scenario – additional EoW criteria on fuels?

The introduction chapter presents an assessment of the current market and technology scenario, which supports the restriction of scope proposed. However, it makes sense to discuss if this restriction is sustainable in the short to medium term (5-10 years), or if market, technology or legislative developments may result in such change of the boundary conditions of end-of-waste that the scope restriction had to be reassessed. Some additional details of such scenario are presented below.

Currently, no coherent and reliable information is available in Europe on waste paper uses outside the paper industry (Stawicki and Read, 2010). In the US, between 4.8% and 7.4% of all waste paper is used outside the paper industry. In Europe, no statistics exist, but estimations from CEPI indicate that the percentage would be similar.

The demand for renewable sources of energy like wood and paper fibre is expected to increase if the strategic EU targets on 20% renewable energy supply by 2020 are to be met[66]. Waste paper could become a material that e.g. municipal incinerators, cement kilns or biomass plants find an appropriate, renewable energy source. Paper is biomass, and it releases neutral CO_2 only. By substituting fossil fuels in a free CO_2 quota market, paper incineration may allow saving CO_2 quotas (currently in the 10-20 EUR/tonne CO_2 range) that can be sold by those facilities that are part of the CO_2 market, such as cement plants and biomass energy plants (but normally not incineration plants).

Currently, dry biomass prices range between 5 and 10 EUR/GJ (75-150 EUR/t), a price higher than steam coal (0.7-2 EUR/GJ, 20-60 EUR/t) but lower than crude oil (7-15 EUR/GJ , 300-500 EUR/t) and its derivate fuels. Waste has in the 90's and beginning of the century been a zero-cost energy resource, most often cement kilns even received a fee for incinerating the waste they took in (mostly homogeneous types such as sludge cakes, homogenised RDF, textile waste, tyres, biomass, animal waste, and hazardous waste like oil, solvents or contaminated sawdust). This is still the case for hazardous waste, but the market for non-hazardous, energy-rich waste seems to have changed in some countries with large municipal incineration capacity. This is because some of the built capacity is now released due to less MSW generation as a consequence of the financial crisis. Most incineration plants are bound through contracts with municipalities and have the duty of treating all MSW generated, but they can also incinerate other non-MSW if they have capacity for that, as they normally sell the heat and electricity they produce. They would therefore be new competitors in the search for alternative fuels, making cement kilns not any longer the exclusive destination of combustible waste. This has resulted in a change in the prices of high calorific value waste, from negative to positive prices in the 5-15 EUR/t range.

The combination of these considerations may create in the future a market situation where it became desirable for cement plants to bid for the lowest priced reclaimed paper grades (20-40 EUR/tonne) for their use as energy source, as such price range is just under the threshold of collection and processing costs of the recycling system. The scenario must be set in the perspective of the historical development of the market, in which these situations are rare, however it could create pressure to develop EoW criteria for fuels derived from waste, including paper.

In case the prospective scenario presented above materialised and a clear market and demand was also identified for EoW for waste paper destined to energy recovery, the proposed criteria on EoW for recycling could be complemented with a separate set of EoW criteria on waste paper for the (very different) specific purpose of energy recovery, not without studying in detail before the interaction, and potential conflicts with e.g. recycling policies and targets.

Early 2011, the IPTS has started studying in detail the suitability for EoW of different fuels derived from waste, including waste types containing paper.

4.3. Legislation

The most important impacts related to legislation are, apart from the release from any obligation under waste legislation (see comments on the Waste Shipments Regulation above), the introduction of product legislation, most notably VAT, REACH, and by-product definitions. From the perspective of both companies and authorities, one of the elements of concern besides compliance is the possible economic impacts of implementation of new legislation.

VAT

Concerns were raised in the technical working group that the end-of-waste status of waste paper may in certain countries affect the applicability of reverse VAT charges, which is an instrument used in some MS to avoid tax evasion.

[66] COM(2008) 30 final. "20 20 by 2020 Europe's climate change opportunity" Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions.

Member States have the authority for deciding whether waste paper that has ceased to be waste is subject to value-added taxation. Member States might request different VAT rates on waste paper once it ceases to be waste.

It should be noted that the end-of-waste criteria are not intended to change the way in which VAT is payable in each Member State. It would therefore be preferable that any provisions on waste paper in national VAT law are formulated in a way that makes them independent on the status as waste or not (end-of-waste). However, it is not within the remit of waste legislation (herewith EoW) to prescribe the VAT rate or regime that any Member State decides to apply to waste paper.

By-product definition

If a given waste paper generated is regarded as being a by-product in the sense of Article 5 of the WFD, and therefore is not waste, then end-of-waste criteria would not apply to it, unless the by-product becomes waste at a later phase. In principle, by-product status should not be an alternative to avoid compliance with end-of-waste, but as discussed in the legislation section in Chapter 2, this can hardly be the case, as the conditions set out for by-products are more restrictive than those of end-of-waste.

REACH

REACH is a European Community Regulation on chemicals and their safe use (EC 1907/2006). It deals with the Registration, Evaluation, Authorisation and Restriction of Chemical substances. The Regulation entered into force on 1 June 2007. The aim of REACH is to ensure a high level of protection of human health and the environment, promote alternative methods for assessment of hazards of substances, and facilitate the free circulation of substances on the internal market.

Under REACH, only substances are subject to registration. The REACH Regulation excludes some substances from its scope, and includes provisions to exempt some other substances from some or many of its requirements.

Waste is excluded from the scope of REACH (Art.2.2), as it is covered by the waste regulatory regime, which ensures equivalent or more demanding control of health and environmental protection risks. As long as waste paper has the status of waste it is thus not subject to most of most of the obligations under REACH. However, when waste paper ceases to be waste according to Article 6 of the WFD, the exemption under Article 2.2 of the REACH Regulation does not apply anymore.

Once waste paper ceases to be waste, it enters the scope of REACH. As explained in detail below, for the purpose of REACH, waste paper that has ceased to be waste is to be considered as a substance or mixture of substances such as cellulose pulp, limestone, and other additives, with or without impurities. The implications of the exemption mentioned above are discussed in detail below.

It is also relevant to note that recycled paper (i.e. the paper product made using some percentage of waste paper fibres that is put on the market) is an article falling under REACH.

REACH includes exemptions to some of its requirements (Titles II on registration, V on downstream users, and VI on evaluation, but not on e.g. data sharing or information down the supply chain) for substances which are known to pose little or no health and environmental risk. Three exempted groups of potential relevance for waste paper and its constituent substances are:

> (a) substances included in Annex IV, as sufficient information is known about these substances that they are considered to cause minimum risk because of their intrinsic properties (art. 2.7.a), e.g. limestone , starch, and cellulose pulp (including lignin);
>
> (b) substances covered by Annex V, as registration is deemed inappropriate or unnecessary for these substances and their exemption from the above mentioned Titles does not prejudice the objectives of REACH Regulation, e.g. substances that occur in nature and are used without further

chemical modification, and are not dangerous[67] (Art.2.7.b, with a list of concerned substances listed in Annex V.7 and V.8, e.g. limestone);

(c) substances, on their own, in preparations or in articles, which have been registered in accordance with Title II and which are recovered in the Community (art. 2.7.d) if:

(i) the substance that results from the recovery process is the same as the substance that has been registered in accordance with Title II (e.g. cellulose pulp, limestone); and
(ii) the information required by Articles 31 or 32 relating to the substance that has been registered in accordance with Title II is available to the establishment undertaking the recovery. (e.g. cellulose pulp, limestone, in case these are not covered by (i)).

As indicated above, the main three substances present in waste paper and not considered impurities (limestone , starch, and cellulose pulp (including lignin)) are covered by one or more of the exemptions of REACH. The classification of these substances according to REACH is described in detail below:

Mixtures, substances and impurities

The Commission issued in October 2008 the document "Waste and Recovered Substances" (CA/24/2008 rev.3 of April 2009), which clarifies the general principles for waste and recovered substances for REACH, and gives useful interpretation for the major recovered materials. This document has been expanded and consolidated by the ECHA in April 2010[68]. The CA/24/2008 rev.3 document, also quoted in ECHA (2010), specifies the considerations to be taken on recovered [sic] paper for the purpose of REACH:

'Recovered paper mainly consists of cellulose pulp. EINECS identifies cellulose pulp as follows: "The fibrous substances obtained from the treatment of lignocellulosic substances (wood or other agricultural fiber sources) with one or more aqueous solutions of pulping and/or bleaching chemicals. Composed of cellulose, hemi-cellulose, lignin, and other minor [sic] components. The relative amounts of these components depend on the extent of the pulping and bleaching processes." (EINECS number 265-995-8).

Cellulose pulp is listed in Annex IV, and consequently, exempted from registration, downstream user and evaluation obligations. Recovered paper may contain other constituents such as pigments, inks, glues, fillers etc. Regarding the recovery and recycling process, constituents that have no specific function in the material (cellulose pulp), can therefore be considered as impurities. Recovered paper consisting exclusively of cellulose pulp with impurities will therefore be exempt from registration, downstream user and evaluation obligations.'

Some types of paper (and subsequently waste paper grades) include a non-minor content, sometimes above 20% in weight in total, of the following three substances: calcium carbonate (limestone), starch and china clay (kaolinite, $Al_2Si_2O_5(OH)_4$). The substance in largest amounts is calcium carbonate, the remaining two in percentages <1%, if at all present. The paper types with highest filler content are graphic papers, where a high mineral load can be needed to provide properties such as glossiness, opacity and brightness.

In paper recycling, cellulose fibres are always targeted. Cellulose pulp is included in Annex IV and therefore exempted from Titles II, V and VI (registration, evaluation and downstream obligations e.g. communication requirements of safety data sheets), but not of Titles III and IV on information in the supply chain.

Conversely, the three mentioned substances, and many other residuals of other additives, are not targeted substances. They are simply accepted in residual amounts, as in most cases they do not provide additional benefits, while they are not damaging either. Only in the production of filler-free recycled paper types such as tissue, are fillers removed. These substances are normally monitored, and adjusted to fit the load desired in the recycled paper product.

In case a waste paper grade has a non-cellulose pulp element in excess of 20% in weight (e.g. mineral fillers), be it a targeted substance or not, the grade should be considered as a mixture of cellulose pulp and

[67] That is, they do not meet the criteria for classification as dangerous according to Directive 67/548/EEC.
[68] ECHA, 2010.

the substance concerned (limestone). In this case, limestone is also in the scope of REACH, as waste paper additives that are in excess of 20% in weight (altogether) will be considered a separate substances to cellulose pulp and will not benefit from the cellulose pulp exemption.

Nevertheless, limestone is also subject to the exemption of Titles II, V and VI, be it as Art.2.7.d, Annex V.8, or Annex IV.

Consequences for waste paper

Under REACH, only substances are subject to registration. In waste paper, not only cellulose pulp, but also other substances present in it may be affected, depending on two conditions:

1) whether their presence is intentional or not, i.e. whether thy are targeted substances, or can be considered impurities.
2) if they are impurities, whether their content is above or below 20% (w/w).

Cellulose pulp is a substance and in the scope of REACH, but as it is mentioned in Annex IV, it is exempted from Titles II, V and VI, and not from the obligations under Title III and Title IV (e.g. Art.32: communication of information down the supply chain for substances for which a safety data sheet is not required).

If any of its additives (limestone, starch, china clay, pigments, inks, glues, etc c.f. section 2.1 on Composition of paper and cardboard) is targeted, then these are covered also by REACH. However, those of them that could be targeted (limestone, starch, china clay, other additives) are either listed in Annex IV or Annex V, or a recovered substances, and consequently, are covered by REACH but exempted from obligations except under Title III and Title IV (e.g. Art.32: communication of information down the supply chain for substances for which a safety data sheet is not required) Starch could be affected by Art.2.7.b, or alternatively Art.2.7. a (Annex IV), and china clay by Art 2.7.b (Annex V).

The remaining additives or substances present (inks, glues, etc, but also plastics, metals, etc) are impurities, i.e. small amounts of elements that do not have a particular function in the recovered material. In case the presence of one of these impurities exceeds 20% (w/w), it shall be considered a substance, part of a mixture. Only limestone can be in such situation and be covered by REACH, but as mentioned above, it is one of the substances also exempted from obligations except under Title III and Title IV (communication of information down the supply chain).

Producers of waste paper applying end-of-waste status have the obligation under REACH to decide which of the cases above applies.

Registration of substances in waste paper with end-of-waste status

Following the argumentation above, all substances contained in waste paper with end-of-waste status are either part of Annex IV, Annex V, or are recovered substances, and therefore all are exempted from Titles II, V and VI, and are not exempted from the obligations under Title III and Title IV (e.g. Art.32: communication of information down the supply chain for substances for which a safety data sheet is not required).

Being substances of common use for many purposes, it can be expected that these conditions can normally be met without disproportionate efforts. This implies that in practice reprocessors will not have to register any substances under REACH. Industry associations can contribute decisively to keep the burden low for companies that want to demonstrate compliance with these conditions.

The Commission invited industry associations to produce guidance documents on drafting safety data sheets relevant for their rectors. CEPI has published in 2009 a "Generic Safety Information Sheet on Recovered Paper and REACH"(CEPI, 2009a), including generic safety data sheets on cellulose pulp and calcium carbonate (limestone).

4.4. Summary of identified potential impacts of EoW on waste paper

Impact	Pros of EoW	Cons of EoW
Health and environment	EoW supports the image of waste paper as a recyclable resource. EoW will likely stimulate in the EU more collection and recycling of waste paper, using untapped recycling potentials in many countries with current low collection rates. EoW will likely stimulate better quality control, and more treatment of waste paper to higher quality. The material exported is on average cleaner. The treatment of non-paper materials remains in the EU.	Be it waste or EoW, there is always a risk that waste paper shipped to non-EU facilities is: * not recycled * recycled but not in accordance with human health and environmental standards that are broadly equivalent to standards established in the EU, including non-paper reject management. The stricter the non-paper component limits (the higher the quality of EoW paper), the lower this risk. However, if the non-paper component threshold is too strict, little waste paper will become EoW, and the potential benefits of the policy will be limited.
Economy and markets	The additional image push of paper as a recyclable resource will likely translate into higher value of this material and its recycling chain, especially the EoW material generated in the EU. Avoidance of administrative costs related to shipment of waste (permits, licenses, uncertainty). Improved functioning of the internal and external market to the EU: transparency, level playing field, etc.	Easier overseas export might tighten the market for waste paper in the EU. When demand is low in the EU, exports overseas supports the activity of the EU recovery chain. When demand in the EU is high, facilitated export strains competition. Additional sorting and quality control will require changes in current practices, which in the short term may result in costs. In the long term, these costs should be lower and be compensated by the benefits of EoW.
Legislation	Improved functioning of the internal and external market to the EU: legal certainty, harmonised rules, etc. Decrease of unnecessary control related to the Waste Shipment Regulation. EoW mechanism materialises recurrent past policy messages that have encouraged improved use of recyclates, and not only punishment of waste generation.	Additional need to meet REACH obligations to provide safety information to downstream users. Each Member State must check the extent of impact to national law, e.g. countries that use reverse VAT or taxation of natural resources in national law.

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6. Glossary and acronyms

Bio-waste: means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants. It includes beverages and foodstuffs.

Collection: (Follows the definition of the Waste Framework Directive (2008/98/EC)): the gathering of waste, including the preliminary sorting and preliminary storage of waste for the purposes of transport to a waste treatment facility.

Collection rate. Percentage of waste paper collection compared to the total paper consumption. Waste paper collected in a country but exported for recycling in another country is included. Waste paper imported from other countries and recycled in a country in question is not included. NOTE: the term used in industry for this concept is *recovery* rate.

Comingled collection: is a multi-material collection system where two or more recyclable materials are deliberately collected together, for later sorting into individual recyclable materials at a dedicated sorting plant. The system can be for pick-up by waste trucks from door to door (also called "kerbside collection") or following a pick-up contract, or be based on regular emptying of containers or banks distributed in the collection areas, and where waste producers bring and deposit their waste (also called "bring systems"). The materials are normally paper, plastics, metals, and sometimes also glass. In some cases, the only allowed plastic, metal and glass is as packaging.

Contraries: see *non-paper components*.

Consignment: means a batch of waste paper for which delivery from a producer to another holder has been agreed; one consignment might be contained in several transport units, such as containers.

De-inking grades: general term used for the family of paper grades that are composed of printed material and require de-inkling for recycling. A large part of it are newspapers made of mechanical pulp. These grades account for about 30% of the total amounts of waste paper collected, and together with the packaging grades (40%) are the bulk of waste paper flows in the EU.

Disposal: (Follows the definition of the Waste Framework Directive (2008/98/EC)): any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy. Annex I of the Directive sets out a non-exhaustive list of disposal operations.

Dry sorting: Sorting of waste paper not based on the use of water. It is used in the context of separation of non-paper components before pulping, referring to the separation waste items not originally part of paper products, or of products (optionally containing paper such as beverage cartons) which one wishes to conduct to a separate stream.

Flexo: Flexography, often abbreviated to flexo, is a form of printing process which utilizes a flexible relief plate. It is basically an updated version of letterpress that can be used for printing on almost any type of substrate including plastic, metallic films, cellophane, and paper. It is widely used for printing on the non-porous substrates required for various types of food packaging.

Health Care waste: wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care), including all its subcategories as detailed in code 18 of Commission Decision 2000/352/EC of 3 May 2000 (List of Wastes).

Holder: means the natural or legal person who is in possession of waste paper.

Importer: means any natural or legal person established within the Union who introduces waste paper which has ceased to be waste into the customs territory of the Union.

Impurity: see non-paper components.

Moisture: means water diffused as vapour or condensed on or in waste paper.

Mono-material collection (system): is a system for the deliberate collection of a single recyclable material, such as paper, plastics, metals, or glass.

Mono-material origin means that waste paper originates from a collection system designed for the collection separately of only one recyclable material, e.g. plastic, metal, paper or glass.

MSW: Municipal solid waste. Means non-sorted, mixed waste from households and commerce, collected together. This waste flow excludes the flows of recyclables collected and kept separately, be it one-material flows or multi-material (comingled) flows.

Mt: Million tonnes. 1 tonne = 1000 kg (International System of Units)

Multi-material collection (system): a system for deliberate collection of two or more recyclable materials together. Normally, Materials are later sorted into mono-material streams at a dedicated sorting plant. Examples of widespread multi-material systems are separate packaging collection systems, and comingled collection systems. The materials collected are normally paper, plastics, metals, and sometimes also glass. In some cases, the only allowed forms of plastic, metal and glass are as packaging.

Multi-material origin means that waste paper originates from a collection system designed for the deliberate collection of two or more recyclable materials together, e.g. plastic, metal, paper and glass. Normally, Materials are later sorted into mono-material streams at a dedicated sorting plant. Examples of multi-material systems are separate packaging collection, and comingled collection.

Non-paper components: also known as contraries or impurities, are materials different from paper, which are present in waste paper. Examples of non-paper components are metals, plastic, glass, textiles, earth, sand, dust, wax, bitumen, ceramics, burnt or fire damaged materials, textiles, leather, rubber, wood and other chemical or organic substances. In addition to this definition, there is a list of materials to which there is zero tolerance e.g. health care waste, hazardous waste, foodstuffs, toxic compounds, or used personal hygiene products. In some contexts the definition of non-paper components comprises only the fraction of the non-paper materials that can be separated by dry sorting, but this definition is not fully appropriate for the purpose of EoW criteria and is therefore not used.

OCC: Old Corrugated Containers, card material made essentially of unbleached sulphate pulp

Packaging grades: general term used for the family of paper grades that essentially do not need de-inking, are non-printed, and are used in packaging applications (boxes, wrapping). A large part of it is corrugated card made of chemical pulp. These grades account for about 40% of the total amounts of waste paper collected, and together with the de-inking grades (30%) are the bulk of waste paper flows in the EU.

Paper: generic term referring to a material composed essentially of cellulose fibres, lignin and inert additives such as clay, calcium carbonate and starch. "Paper" refers to both paper and cardboard.

Paper and Board Detrimental to Production: Paper types not matching the quality definition of a batch, bale or lot of paper (e.g. brown packaging cardboard pieces in newspapers). Paper and board which have been recovered or treated in such a way that they are, for a basic or standard level of equipment, unsuitable as raw material for the manufacture of paper and board, or are actually damaging, or whose presence makes the whole consignment of paper unusable.

Note: A growing number of mills have adapted treatment plants to handle such paper types, and the range of papers and boards capable of being recycled is increasing all the time as technology develops. In general, purchaser and supplier agree to a certain proportion of unusable materials.

Paper Consumption: Paper that is delivered (purchased) and used within a list of countries, plus imports from countries outside the list of countries.

Paper Production: Paper that is manufactured by a list of countries. Some of it is unsold, some of it is sold in the market within the list of countries, and some of it is exported.

Paper manufacture: the only-paper issue, excluding other paper products like animal bedding.

Producer: means the holder who transfers waste paper to another holder for the first time as waste paper which has ceased to be waste.

Prohibited materials: Any materials in waste paper which represent a risk for health, safety and environment, such as health care waste, used products of personal hygiene, hazardous waste, organic waste including foodstuffs, bitumen, toxic powders and the like.

Qualified staff: means staff which is qualified by experience or training to monitor and assess the properties of waste paper.

RDF: Refuse-derived fuel. Generic term that defines a fuel obtained from waste. Normally it refers to a fraction of MSW essentially composed of paper, plastics, textiles and wood, and obtained by removal of readily biodegradable material and moisture, glass, and metals.

Recovered paper identification system. Is a database system that allows to register waste paper consignments and parts of them (to the level of a bale), linking a consignment to its supplier, and where needed, passing information up and down the supply chain. It was set up to allow paper mills to identify the origin of the waste paper purchased, received, stored and consumed by the paper mills. Traceability is made possible when necessary by the combination of supplier codes and loading documents. The system is designed for use internationally, and is available free of charge to any supplier / buyer of waste paper globally. The system has been agreed by the three European associations of suppliers and buyers (The Confederation of European Paper Industries (CEPI), the European Federation of Waste Management and Environmental Services (FEAD) and the European Recovered Paper Association (ERPA), and is designed to protect commercially sensitive information and to minimize the administrative burden of all parties involved. More information is available on http://www.recoveredpaper-id.eu/

Recovery: (Follows the definition of the Waste Framework Directive (2008/98/EC)): any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy. Annex II of the Directive sets out a non-exhaustive list of recovery operations.

***Recovery* Rate:** See *collection rate* above

Recycled Paper: A broad term, generally applied to any sort of paper product containing to some degree fibres from waste paper, and not only virgin paper fibres. Paper can currently be labelled recycled if even only a small percentage of it is made from waste paper. The term does not currently imply or guarantee that it is manufactured with any additional environmental consideration. Case-by case labelling will indicate the type and percentage of recycled paper content.

Recycling: (Follows the definition of the Waste Framework Directive (2008/98/EC)): any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Recycling Rate: Percentage of waste paper utilisation (paper which is reused for making new paper) compared to the total paper consumption.

Reprocessing plant*:* broad term used to define any of the intermediate actors in the waste paper chain between the end-users and the paper mills. It encompasses companies or institutions undertaking activities such as collection, sorting, grading, classification, cleaning, baling, trading, storing, or transporting. The inlet material to these plants is waste paper. The outlet is paper that may either be waste or non-waste.

Reprocessor: operator of a reprocessing plant (see above).

Separate collection: (Follows the definition of the Waste Framework Directive (2008/98/EC)): the collection where a waste stream is kept separately by type and nature so as to facilitate a specific treatment.

Treatment: (Follows the definition of the Waste Framework Directive (2008/98/EC)): recovery or disposal operations, including preparation prior to recovery or disposal.

Unusable or Unwanted Materials, also termed **"Outthrows".** A term encompassing both non-paper components and paper and cardboard detrimental to production of paper. In general, purchaser and supplier agree to a certain proportion of unusable materials.

Utilisation Rate: Percentage of waste paper utilisation (paper which is reused for making new paper) compared to total paper production (by all means: using virgin plus waste fibres).

Visual inspection: means inspection of consignments using either or all human senses such as vision, touch and smell and any non-specialised equipment. Visual inspection shall be carried out in such a way that all representative parts of a consignment are covered. This may often best be achieved in the delivery area during loading or unloading and before packing. It may involve manual manipulations such as the opening of containers, other sensorial controls (feel, smell) or the use of appropriate portable sensors.

WFD: Waste Framework Directive (DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 November 2008 on waste and repealing certain Directives).

Waste paper: Refers to both paper and cardboard which the holder discards, intends to discard or is required to discard, which has been separately collected for the purpose of recycling and consists mainly of cellulose fibres, lignin and inert additives such as clay, calcium carbonate and starch.

Waste Paper Collection: Separate collection of paper from industrial, commercial, households, and offices, with the purpose of its recovery, including recycling. NOTE: In this document, only collection for recycling is covered.

Waste Paper Utilisation: Use of waste paper as raw material at paper mills for paper production.

7. Annex I. Criteria

This Annex presents a compact version of the proposed criteria for end-of-waste on waste paper, without explanatory text, to allow an overall perception of the set of criteria, and how the criteria depend on each other as a package (some sentences have been reformulated in this compacted version as to make clear these dependencies across the text).

CRITERIA DETERMINING WHEN CERTAIN TYPES OF PAPER WASTE CEASE TO BE WASTE

Waste paper shall cease to be waste where, upon transfer from the producer to another holder, or prior to its use at a papermill, it complies with all the following criteria and conditions:

Criteria	Self-monitoring requirements
1. Quality of waste paper resulting from the recovery operation	
1.1 The waste paper **shall be graded** according to the European specification[69] "*EN-643- Paper and board - European list of standard grades of recovered paper and board*".	Qualified staff[70] shall grade each consignment.
1.2 The **non-paper component** content shall be ≤ 1.5 % of air dried weight. A **non-paper component** is any material different from paper, which is present in waste paper, and can be separated using dry sorting techniques. Examples of non-paper components are metals, plastic, glass, textiles, earth, sand, ash, dust, wax, bitumen, ceramics, rubber, fabric, wood, and synthetic organic substances. Mineral fillers bound to paper fibres such as clay, calcium carbonate, and starch are considered as part of paper and do not count as non-paper components. Packaging board and paper sacks consisting of layers of paper and of non-paper materials, such as beverage cartons, count as non-paper components.	Qualified staff shall carry out visual inspection[71] of each consignment. At appropriate intervals subject to review if significant changes in the operating process are made, representative samples of each grade of waste paper shall be analysed gravimetrically to measure the content of non-paper components. The non-paper components content shall be analysed by weighing after mechanical or manual (as appropriate) separation of materials under careful visual inspection. The appropriate frequencies of monitoring by sampling shall be established taking into account the following factors: (1) the expected pattern of variability (for example as shown by historical results); (2) the inherent risk of variability in the quality of the waste used as input for the recovery operation and any subsequent processing, for instance the higher average content of plastics or glass in waste paper from multi-material collection systems; (3) the inherent precision of the monitoring

69 NOTE: if possible, it would be desirable to formulate the reference to EN-643 in a way that is not dependent on its update.
70 Qualified staff means staff which is qualified by experience or training to monitor and assess the properties of waste paper
71 "visual inspection" means inspection of consignments using either or all human senses such as vision, touch and smell and any non-specialised equipment. Visual inspection shall be carried out in such a way that all representative parts of a consignment are covered. This may often best be achieved in the delivery area during loading or unloading and before packing. It may involve manual manipulations such as the opening of containers, other sensorial controls (feel, smell) or the use of appropriate portable sensors.

Criteria	Self-monitoring requirements
	method; and (4) the proximity of results to the limitation of the non-paper components content to a maximum of 1.5 % of air dried weight. The process of determining monitoring frequencies should be documented as part of the quality management system and should be available for auditing.
1.3 The waste paper, including its constituents and in particular ink and dyes, shall not display any of the **hazardous properties** listed in Annex III to Directive 2008/98/EC. The waste paper shall comply with the concentration limits laid down in Commission Decision 2000/532/EC[72] , and not exceed the concentration limits laid down in Annex IV of Regulation 850/2004/EC[73].	Qualified staff shall carry out a visual inspection of each consignment. Where visual inspection reveals any indications for possible hazardous properties further appropriate monitoring measures have to be taken, including, if appropriate, sampling and testing. The staff shall be trained on potential hazardous properties that may be associated with waste paper and on material components or features that allow recognising the hazardous properties. The procedure of recognising hazardous materials shall be documented under the quality management system.
1.4 Waste paper must not contain absorbed oil, solvents, paint, aqueous and/or fatty foodstuffs, that can be detected by visual inspection.	Qualified staff shall carry out a visual inspection of each consignment. Where visual inspection reveals signs of biological or chemical contamination, e.g. by mould growth or odours, and these signs are non-negligible, the consignment shall remain waste. The staff shall be trained on potential types of contamination that may be associated with waste paper and on material components or features that allow recognising the contaminants. The procedure of recognising contamination shall be documented under the quality management system.
2. Waste used as input for the recovery operation	
2.1 Hazardous waste, bio-waste, mixed municipal waste, health care waste, and used products of personal hygiene shall not be used as input.	Acceptance control of all paper-containing waste received by visual inspection and of the accompanying documentation shall be carried out by qualified staff which is trained on how to recognise paper-containing input that does not fulfil the criteria set out in this section.
3. Treatment processes and techniques	
3.1 Waste paper streams used as input shall, once received by the producer or importer, be kept permanently separate from the contact with any other waste, including other waste paper grades.	

[72] OJ L 226, 6.9.2000, p. 3.
[73] OJ L L 229, 30.4.2004, p. 1.

Criteria		Self-monitoring requirements
3.2	All treatments needed to prepare the waste paper for direct input to pulping in the manufacture of paper products, such as sorting, separating, cleaning, or grading, and except de-baling, shall have been completed.	

QUALITY MANAGEMENT

1. The producer shall implement a quality management system suitable to demonstrate compliance with the EoW criteria referred to above.

2. The quality management system shall include a set of documented procedures concerning each of the following aspects:

   (a) monitoring of the quality of waste paper resulting from the recovery operation described in the Criteria section 1 above (including sampling and analysis);

   (b) acceptance control of waste used as input for the recovery operation described in the Criteria section 2 above;

   (c) monitoring of the treatment processes and techniques described in the Criteria section 3 above;

   (d) feedback from customers concerning the product quality;

   (e) record keeping of the results of monitoring conducted under points (a) to (d);

   (f) review and improvement of the quality management system;

   (g) training of staff.

3. The quality management system shall also prescribe the specific monitoring requirements set out in Annex I for each criterion.

4. Where any of the treatments referred to in Section 3 of the Criteria is carried out by a prior holder, the producer shall ensure that the supplier implements a quality management system which complies with the requirements on quality management here described.

5. The importer shall require his suppliers to implement a quality management system which complies with the requirements on quality management described in paragraphs 1 to 3 above.

6. A conformity assessment body as defined in Regulation (EC) No 765/2008 or an environmental verifier as defined in Regulation (EC) No 1221/2009 shall verify that the quality management system complies with the requirements on quality management here described. The verification should be renewed in the event of any change at least on a three-yearly basis.

7. The producer shall give competent authorities access to the quality management system upon request.

The producer or the importer shall issue, for each consignment of waste paper, a statement of conformity as set out below. The producer or the importer shall transmit the statement of conformity to the next holder of the consignment. They shall retain a copy of the statement of conformity for at least one year after its date of issue and shall make it available to competent authorities upon request. The statement of conformity may be issued as an electronic document.

1.	Producer of the waste paper: Name: Address Contact person Telephone.: Fax: E-mail:
2.	a) The grade of waste paper in accordance with standard EN-643: b) The content of non-paper components, in percentage points of air dry weight: c) Origin of the material (tick where appropriate) c.1) MULTI-MATERIAL ORIGIN c.2) MONO-MATERIAL ORIGIN
3.	Quantity of the consignment in kg.
4.	The consignment complies with the specifications of standard EN-643.
5.	This consignment meets the criteria referred to in this Regulation
6.	The producer of the waste paper applies a quality management system complying with the requirements of this Regulation, and which has been verified by an accredited verifier (this does not apply when waste paper which has ceased to be waste is imported into the customs territory of the Union)
7.	THE MATERIAL IN THIS CONSIGNMENT IS INTENDED EXCLUSIVELY FOR THE MANUFACTURE OF PAPER.
8.	Declaration of the producer of the waste paper: I certify that the above information is complete and correct and to my best knowledge: Name: Date: Signature:

Note1: Items 2(a), 2(c) and 4 are a highlight of key information issues already required under item 5, which refers to quality criterion no. 1.1. on the grading of the consignment following EN-643, in which these items are included. They are a reiteration, but most experts have supported to include these elements as a part of the criteria.

Note 2: Some industrial stakeholders (FEAD, BIR) have requested that the terms "multi-material origin" and "mono-material origin" under p.2(c) are explicitly defined in the statement of conformity, as they see the statement will have a life somehow independent from the Regulation, which would likely include these definitions in the recitals. The definitions proposed are the following:
Multi-material origin means that waste paper originates from a collection system for deliberate collection of two or more recyclable materials together, e.g. plastic, metal, paper and glass. Materials are later sorted into mono-material streams at a dedicated sorting plant.
Mono-material origin means that waste paper originates from a collection system designed for the collection separately of only one recyclable material, e.g. plastic, metal, paper or glass

Note 3:

Some stakeholders suggest that Point 2(b) bears a clarification note where it states that it will not be possible to state the content of non-paper components for every consignment of waste paper. The Quality Management Systems and risk-based monitoring will provide a level of confidence that the consignment is below the 1.5% threshold, but will not provide an actual measurement for every consignment. The statement of conformity would in that case clarify that the results of the risk-based monitoring demonstrate compliance with the 1.5% limit on non-paper components.

This proposal has not been included, as (1) compliance with the limits is required in all cases, and (2) the self-monitoring requirements include the essential demands to sampling.

The following definitions could be included in the recitals of a legal text:

(1) "waste paper" means paper and cardboard which the holder discards, intends to discard or is required to discard, which has been separately collected for the purpose of recycling and consists mainly of paper fibres, lignin and inert additives such as clay, calcium carbonate and starch.

(2) "holder" means the natural or legal person who is in possession of waste paper.

(3) "producer" means the holder who transfers waste paper to another holder for the first time as waste paper which has ceased to be waste.

(4) "importer" means any natural or legal person established within the Union who introduces waste paper which has ceased to be waste into the customs territory of the Union.

(5) "qualified staff" means staff which is qualified by experience or training to monitor and assess the properties of waste paper.

(6) "consignment" means a batch of waste paper for which delivery from a producer to a holder has been agreed; one consignment might be contained in several transport units, such as containers.

(7) "visual inspection" means inspection of consignments using either or all human senses such as vision, touch and smell and any non-specialised equipment. Visual inspection shall be carried out in such a way that all representative parts of a consignment are covered.

(8) "multi-material origin" means that waste paper originates from a collection system designed for the deliberate collection of two or more recyclable materials together, e.g. plastic, metal, paper and glass. Normally, materials are later sorted into individual recyclable materials at a dedicated sorting plant. Examples of multi-material systems are separate packaging collection, and comingled collection.

(9) "mono-material origin" means that waste paper originates from a collection system designed for the collection separately of only one recyclable material, e.g. plastic, metal, paper or glass.

(10) "Paper" means a material composed essentially of cellulose fibres, lignin and inert additives such as clay, calcium carbonate and starch. "Paper" refers to both paper and cardboard.

Notes on definitions:

Some stakeholders have suggested the use in the legal text to be prepared of the term *paper for recycling* to refer to waste paper collected for the purpose of production of new paper, i.e. do not use the term *waste paper,* because of its negative connotation.

Some stakeholders have suggested to expand the definition of producer as follows: "producer" means the holder who transfers waste paper to another holder for the first time as waste paper which has ceased to be waste, *or holds material that has ceased to be waste prior to its final use at a papermill.*

Some stakeholders call for clarification of what is meant by "transfer" in the definition of producer, e.g. physical transfer of the consignment off site, or economic transfer? To provide clarity for enforcement officers, they would prefer the definition to be linked to the physical transfer of the consignment. In the definition of holder, some stakeholders call for clarification of what is meant "possession" e.g. physical or legal.

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Abstract

This report presents proposals of end-of-waste (EoW) criteria for waste paper, defining the technical requirements that waste paper has to fulfil in order to cease to be waste in the EU. The report includes the background data and assessments used to support the proposals, including a comprehensive techno-economic analysis of waste paper recycling, and analyses of the potential economic, environmental and legal impacts when waste paper ceases to be waste.

This report is a contribution to the implementation of the concept of End-of-waste in EU legislation, a mechanism introduced through Article 6 of the Waste Framework Directive (2008/98/EC). The Directive introduces the possibility that certain waste streams having undergone a recovery operation and fulfilling certain criteria – so-called End-of-waste criteria – can cease to be waste. The criteria have to ensure that the waste streams fulfil a number of conditions, including the existence of a commonly used specific applications, existence of a market or a demand, fulfilment of technical requirements for the specific applications, meeting existing legislation and standards applicable to the products the waste streams substitute; and the absence of any overall adverse environmental or human health impacts.

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