ANALYSIS OF PACKAGING WASTE GENERATION AND MANAGEMENT IN SPAIN

Paneque, A.

Cháfer, C.

Pacheco, B.

Capuz-Rizo, S.F.

Universidad Politécnica de Valencia

Hortal, M.

Instituto Tecnológico del Embalaje, Transporte y Logística (ITENE)

Abstract

The objectives for packaging waste valorization set out by the European Union for 2008 have mostly been achieved in Spain. However, generation of packaging waste continues to rise following economic growth very closely. This paper presents an analysis of the current situation of packaging waste production in Spain compared to other types of waste and its evolution in the last years indicating some factors which may have affected waste streams. In addition, some actions and policies that are being taken are also described: prevention in packaging waste generation and waste material and energy recovery.

***Keywords**: Packaging waste, waste management*

1. Introduction

Packaging waste is any package or packaging material thrown away by users. Packaging materials soon become packaging waste, which generate significant amounts of waste that enter the waste disposal, recycling, and recovery streams, contributing to the environmental impacts brought about by these activities.

The characteristics of packaging waste vary depending on the type of material of which the packaging is composed. Household waste comes from households and it may have a primary (sales packaging) and secondary (group packaging) sources from products purchased by the end consumer in shops. Household waste is recovered by selective collection, or by defect, by mixed USW (urban solid waste) collection. On the other hand, industrial or commercial packaging waste is waste from packaging whose use and consumption takes place exclusively in industries, shops, services or farms (BOE, 1997). Tertiary (transportation packaging) and secondary packaging that are used to group quantities of packaged goods for distribution and for display in shops and thus are not acquired by the end consumers make up the third type of packaging waste (Aucejo et al., 2007). In this case, the sales point should provide proper waste disposal and management systems, generally through agreements with authorized waste

managers. Industrial packaging waste is more easily recoverable than household waste due to the great quantity, concentration, homogeneity and quality of the waste.

Regarding waste composition, packaging waste can be composed of different materials, such as paper, cardboard, glass, wood, plastic or metal either individually or mixed (complex packages). For example, wood is widely used in the manufacture of pallets; plastic in food packaging, and glass in beverage packaging.

2. Packaging waste generation in Spain

Packaging waste generation has steadily increased between 1997 and 2005, rising by about 33.66% as shown in Figure 1. The reason for the apparent reduction in the amount of waste generated in the years 2001 and 2002 is actually due to the lack of available data about wood waste and the so called "other materials" waste. There is also no accurate data available on wood waste generation in 1997, but it was included in the "other materials" waste category. In 2005 a total amount of 177 kg packaging waste per capita was generated in Spain. (http://ec.europa.eu/environment/waste/packaging/data.htm).

Figure 1 was elaborated from the data of the European Commission about the different EU member states with the aim of monitoring the compliance of the EU's directive. In turn, each member state collects the data supplied by the entities and organizations in charge of packaging waste management. Some of such Spanish entities are Ecoembes, Ecovidrio, Recipap/Aspapel, Cicloplast, Ecoacero, Arpal or Fedemco (MMA, 2007).

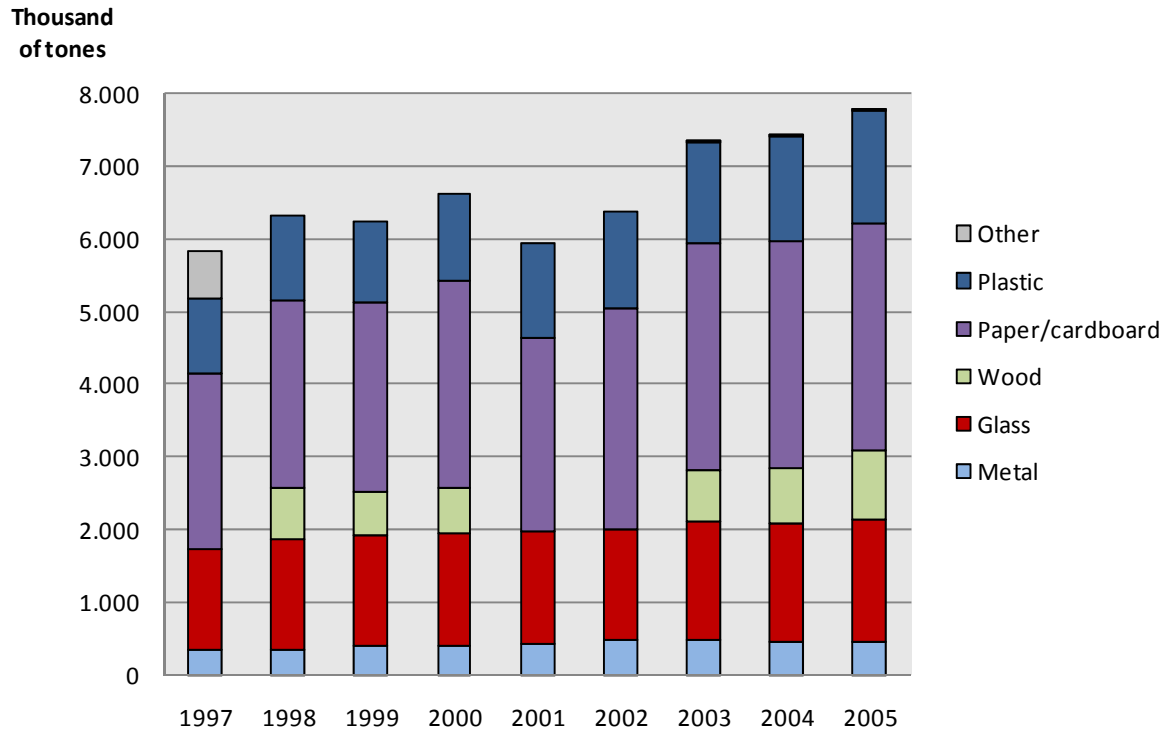

Figure 1: Packaging waste generation in Spain (1997 – 2005). Source: Elaborated by the authors based on the data of the European Commission (http://ec.europa.eu/environment/waste/packaging/data.htm).

Figure 1 shows the distribution of the amount of packaging waste by material. Paper and cardboard are the most widely used packaging materials in terms of weight, followed by glass and plastic with similar amounts. In 2005, paper and cardboard accounted for 40.28% by

weight of all packaging, glass 21.47%, plastic 20.12%, wood 12.12%, metals 6.02% and other materials 0.25%. Observe that, although glass and plastic present similar percentages, the number of disposed individual plastic containers is higher than that of glass.
Plastic is by far the material that has increased the most over this period. Plastic packaging waste increased by 51.68% in detriment of glass waste, which only increased by 19.96%, thus becoming the packaging waste material with the least growth. A moderate increase can be observed for metals (+37.47%), wood (+36.52% between 1998 and 2005) and paper-cardboard (+30.02%).
Generation of packaging waste is closely related to current production and consumption trends in our society, so that it follows the growth of GDP very closely, i.e. the wealthier a country becomes the more it consumes and the more waste it generates. For this reason, the big challenge of waste management policies is the "de-coupling" of waste generation from economic growth (AEMA, 2004).

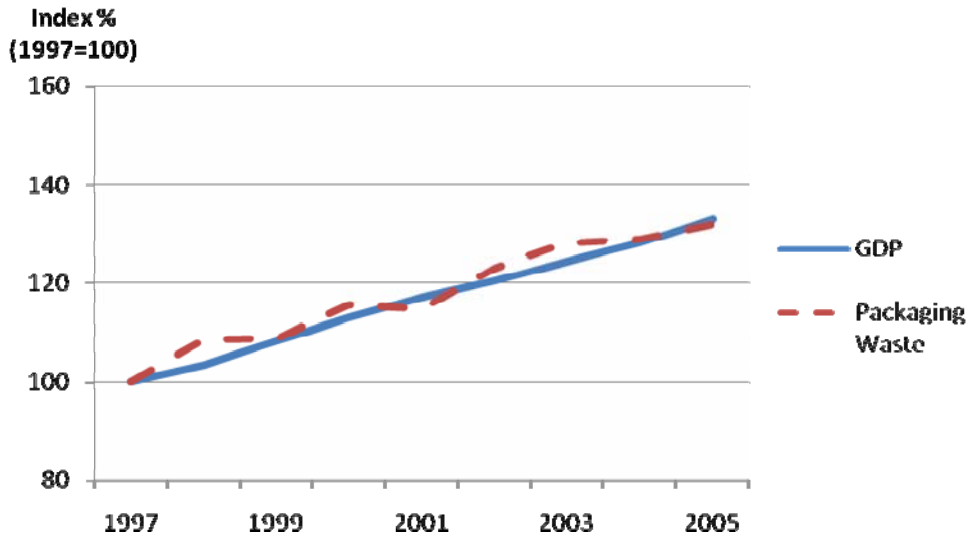

Figure 2: Evolution of packaging waste (PW) generation vs GDP in Spain (1997-2005), taking 100 in 1997 as base year. Source: Elaborated by the authors based on the data of the European Commission (http://ec.europa.eu/environment/waste/packaging/data.htm) and the INE (www.ine.es).

Figure 2 represents the evolution of GDP vs the generation of metal, plastic, cardboard and glass packaging waste, expressed in percentage taking 1997 as base year. Wood packaging waste has been excluded from the graph because of the lack of data available for the years 1997, 2001 and 2202, as mentioned earlier. The growth of the Gross Domestic Product in the period between 1997 and 2005 has been closely followed by an increase in the amount of packaging waste generated.

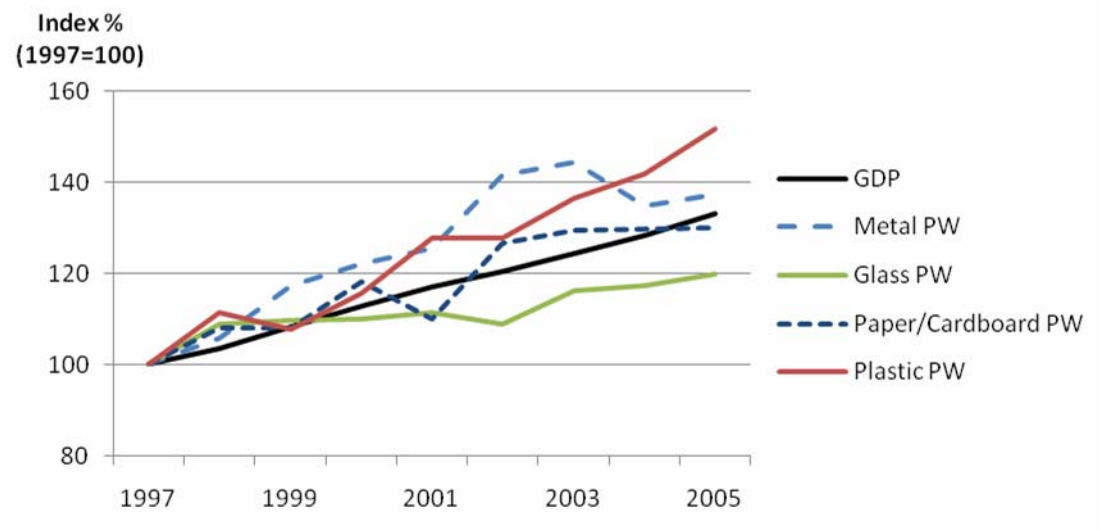

Figure 3: Evolution of packaging waste generation vs GDP in Spain (1997-2005), taking 1997 as base year. Source: Elaborated by the authors based on the data of the European Commission (http://ec.europa.eu/environment/waste/packaging/data.htm) and the INE (www.ine.es).

Figure 3 presents the rates of packaging waste generated by material (expressed in percentage for the four materials under analysis) vs the GDP.

Observe that plastic packaging waste is the type of waste that grew the most, far beyond the GDP, whereas glass packaging waste shows a lower increase. Regarding metal packaging waste, it grew faster than the GDP until 2002, but since then it has experienced a slight reduction. This is due to the evolution of packaging technology and the changes in the consumption habits of Spanish consumers.

Among the factors that affect this growing trend of packaging waste generation we can mention:

- The reduction in the size of family homes brings about a higher consumption of individual packages to avoid wasting products (out of date products), which in turn results in an increase in the amount of individual packaging (Ecoembes, 2003).

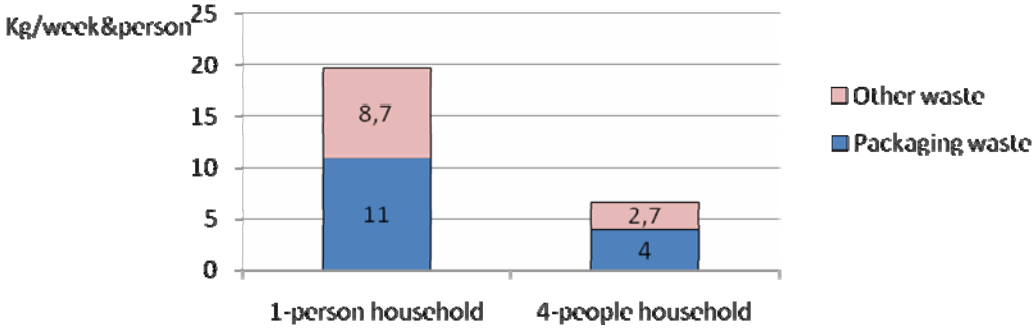

Figure 4: Waste generation per capita according to home size (Ecoembes, 2003).

- The consumption of pre-cooked food, of an increasing demand in developed countries, is closely linked to the generation of packaging waste. The lack of time for cooking or shopping leads to an increased consumption of packaged and pre-cooked food (AEMA, 2004).
- A higher purchasing power allows consumers to buy customized products, that is, adapted to the consumers' needs, instead of a single larger product for all the family

members. Food, hygiene and beauty industries are the most strongly affected by this reduction in package size (Ecoembes, 2003).

- Market globalization means that the goods manufactured in one part of the world must arrive in perfect conditions at the end consumer thousands of kilometres away, which results in more quantity of packaging per product.

3. Packaging waste management

The prevention of packaging waste generation is a key factor of any waste management strategic policy and system. Reducing the amount of packaging waste and the toxic components in the waste greatly simplify the tasks of waste management. This reduction should take place during the process of packaging design. Packaging design must ensure packaging functionality as well as reduce the environmental impacts associated with the package life cycle. Some strategic actions for environmentally-friendly packaging design are the selection of low-impact or "clean" materials, limited use of materials, optimization of production techniques, optimization of product distribution systems and optimization of the product life cycle (Capuz et al, 2004).

Royal Decree 782/1998 of 30 April sets down the regulations for the development and implementation of Law 11/1997 on Packaging and Packaging Waste. One of the key mechanisms set in the Law to meet the waste prevention and reduction objectives and targets are the Business Plans for Waste Prevention.

The Business Plans for Waste Prevention use indicators such as reducing the weight of the materials used in packaging, increasing the number of reusable packages over one-way systems and recyclable over non-recyclable packaging, limiting unnecessary packaging or using secondary raw materials obtained from packaging waste recycling.

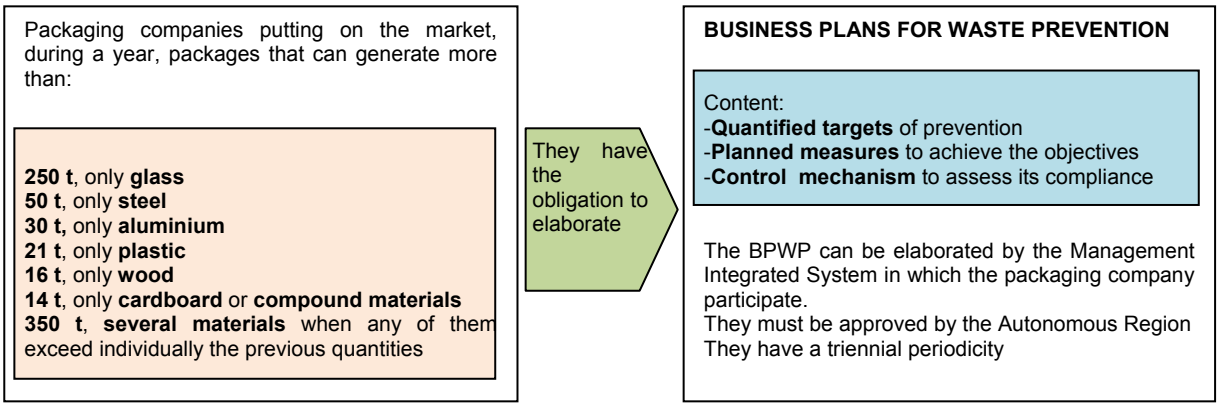

Figure 5: Commitment of developing a Business Plan for Waste Prevention. Source: Elaborated by the authors based on Hortal et al., 2006.

Despite these prevention measures, as mentioned earlier, the quantity of packaging waste continues to grow. Any end-of-life treatment of a packaging waste product causes environmental impacts. According to the binding hierarchy of disposal options set out in Law 10/1998 on Waste Disposal the different possible alternatives of waste management are prioritized according to their associate environmental impact from low to high as follows: Prevention, re-use, recycling, energy valorization and disposal (landfill and incineration with no or low energy recovery).

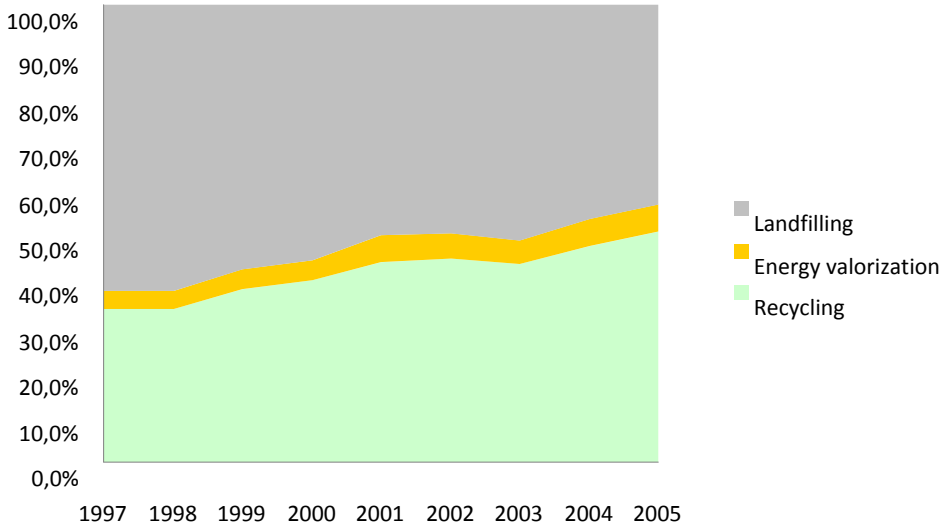

Figure 6: End-of-life treatments of packaging waste in Spain. Source: Elaborated by the authors based on the data of the European Commission (http://ec.europa.eu/environment/waste/packaging/data.htm).

Figure 6 presents the evolution rates of waste recycling, energy valorization and landfilling. Till 2004 the amount of dumped packaging waste was higher than that of valorized waste. In 2005, a total amount of 56.1% was valorized, 54.4% by the recycling method and 5.7% by energy valorization.

Recycling is the product end-of-life treatment that has changed the most since 1997, increasing by 50.45%. Energy valorization has increased by 42.5% and landfilling has decreased by 29.76%.

The comparison of the evolution rates of the end-of-life treatment methods in Spain and the European Union reveals that until the most recent data available for 2004, the recycling and energy valorization rates in Spain are lower than the European average rates. The greatest difference can be observed in the energy valorization rates as the European rate in 2004 was about twice as much as in Spain (11% in the EU vs 5.6% in Spain).

However, with these overall valorization and recycling rates, Spain approaches the targets set out for 31 December 2008 by Directive 2004/12/CE (which amends Directive 94/62/CE).

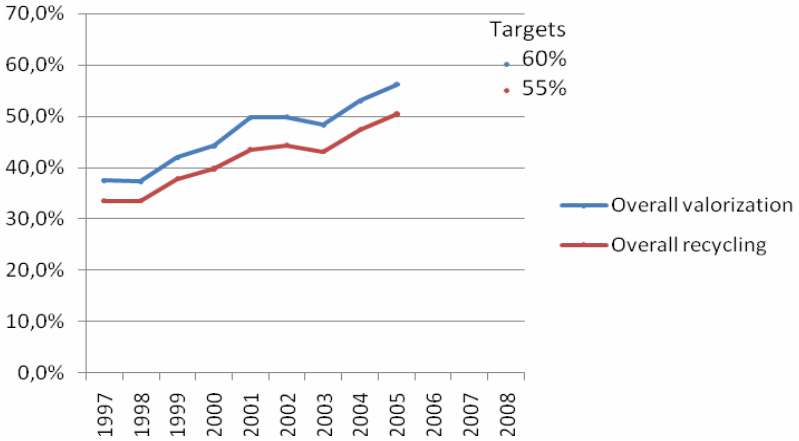

Figure 7: Evolution of the overall rates towards the targets set out for 2008. Source: Elaborated by the authors based on the data of the European Commission (http://ec.europa.eu/environment/waste/packaging/data.htm).

Packaging end-of-life treatments depend on the type of material of which the packaging is composed, according to whether it can be easily recycled or used as fuel.

Metals have the second lowest recycling rate after paper-cardboard. Metal recycling brings about substantial water and energy savings as compared to metal extraction from the ore. Ferrous metals are easily recoverable by means of electromagnets; by contrast, non-ferrous metals require more sophisticated recovery techniques. In 2005 a total amount of 59.7% metal packaging waste was recycled, 1.4% was valorized and 38.9% was dumped. The European target of 50% metal recycling has been exceeded since 2004.

Glass is a material easy to identify and sort out for further recycling and, among other advantages, the re-use of glass containers as raw material for the manufacture of new glass containers saves substantial amounts of energy. During 2005 a total amount of 44.4% glass waste was recycled and the rest (55.6%) was dumped. Due to its properties, glass cannot be energetically valorized. The 60% target for glass recycling has not been met yet as there is still 15.6 percentage points missed to meet the objective set in Directive 2004/12/CE.

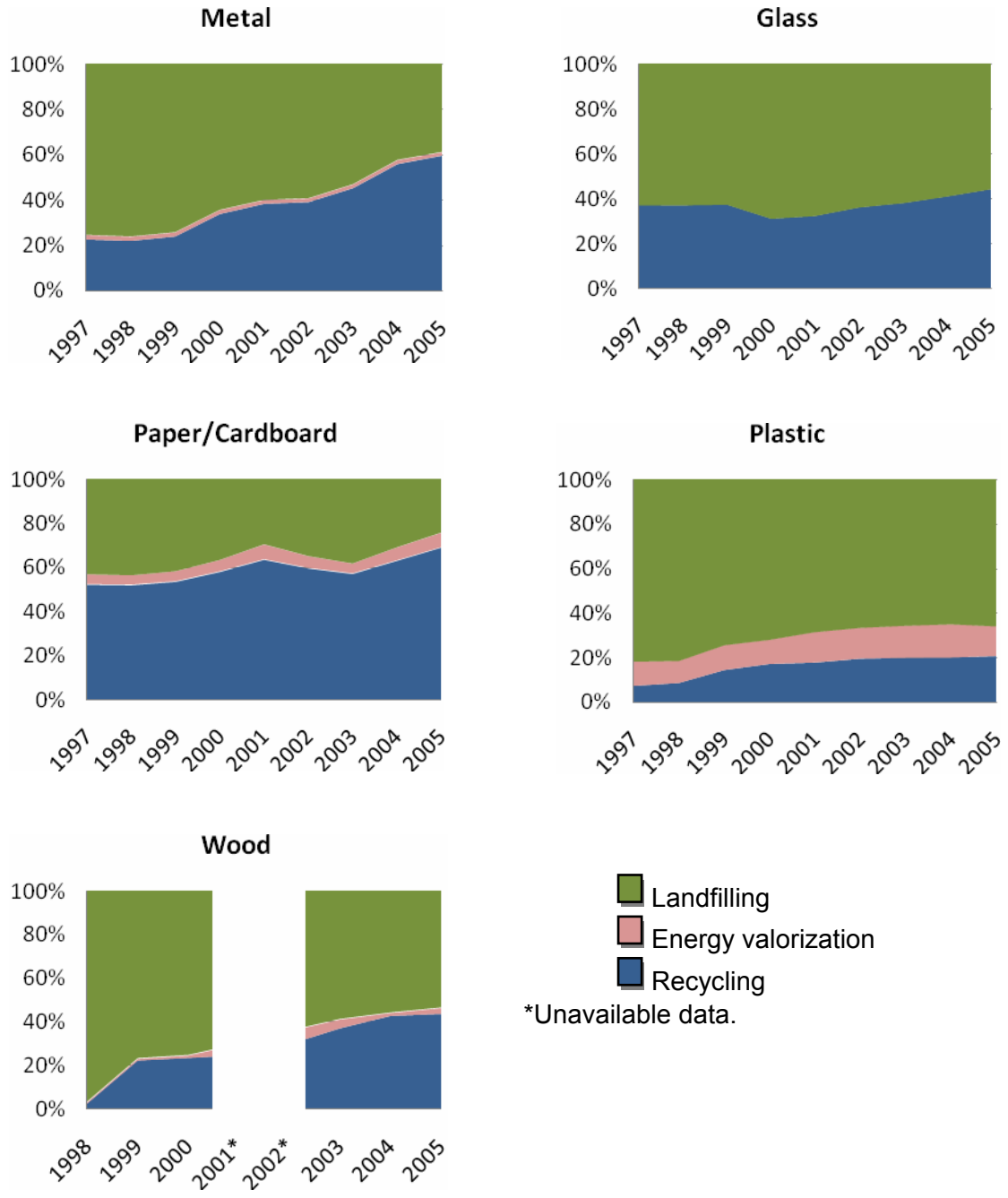

Figure 8: Packaging end-of-life treatments by material. Source: Elaborated by the authors based on the data of the European Commission (http://ec.europa.eu/environment/waste/packaging/data.htm).

Paper and cardboard possess high calorific value so that they can be incinerated and the energy recovered. After plastic, paper and cardboard wastes present the highest energy valorization. However, their high value as raw material for the paper industry prevents the use of natural cellulose from woods; this along with its facility to be recycled causes this type of packaging waste to present the highest recycling rates. In 2005 a total rate of 69.2% paper waste was recycled and 24.3% was dumped. In 2004 the objective of 60% paper and cardboard recycling for 2008 was exceeded.

Plastic is the most energetically valorized material although it is also the most frequently dumped to landfills. Plastic packaging waste possesses a high calorific value so that it is used as fuel in solid urban waste incineration plants. Additionally, there is a great variety of plastics that have to be previously sorted out for further recycling, thus increasing the cost of recycling. According to the 2005 data, a total amount of 20.7% plastic packaging waste was recycled, 13.4% was energetically valorized and the remaining 65.9% was dumped. With these rates, plastic lies 1.8 percentage points below the EC target of 22.5%.

Finally, wood is a material with a high potential to be energetically valorized due to its combustible capacity, but wood packaging waste is also used in the manufacture of conglomerate boards. In addition, some wood packages, e.g. pallets, are frequently re-used either by the company itself or supplied by recyclers (second-hand pallets). In 2005 a total amount of 43.9% wood packaging waste was recycled, 2.6% was energetically valorized and 53.4% was dumped. Therefore, the European objective of 15% has been significantly exceeded.

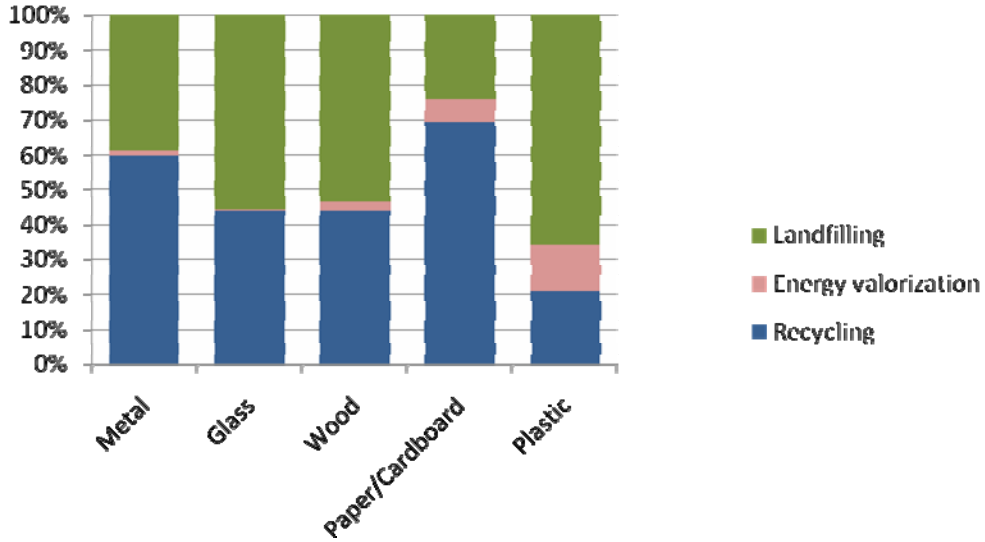

Figure 9: Packaging end-of-life treatments by material (2005). Source: Elaborated by the authors based on the data of the European Commission (http://ec.europa.eu/environment/waste/packaging/data.htm).

Figure 9 shows the comparison of the end-of-life treatments of the different packaging wastes by material using the 2005 data. As can be observed:

- Plastic is the most frequently dumped, less commonly recycled and most energetically valorized material
- Paper and cardboard are the materials with the highest recycling rate, the second in energy valorization and the least frequently dumped to landfills
- Glass and wood present similar recycling rates; but due to the fact that glass, unlike wood, is energetically little valorized, the volume of dumped glass waste is slightly greater
- The rates of dumped metals are only slightly higher than those of paper or cardboard thanks to the great efforts made in metal recovery and recycling because of their high economic value

4. Conclusions

European current trends tend to reduce the amount of packaging waste that ends its life in open dumps or landfills (AEMA 2007). For this end, the solution is to recycle or energetically valorize larger amounts of waste. As mentioned earlier in the paper, energy valorization is more or less feasible depending on the type of waste material.

In the case of plastic packaging waste, the trend is to increase the amount of energetically valorized plastic either by the incineration method with energy recovery or by alternative processes like gasification (Cicloplast 2005).

As regards paper and cardboard, paper industries bet for raising the recycling tax through the improvement of the paper waste collection systems and using the incineration method only when the paper conditions prevent it from being recycled.

With respect to glass and metals, the trend is to increase their recycling rates and reduce the amount of dumped waste.

Regarding wood packaging waste, in addition to increasing its recycling rate, the trend is to significantly increase its energy valorization rate and take advantage of the combustible properties of this material.

As for the reduction in waste generation by means of prevention measures, it is a task that concerns all stakeholders involved in the process (Public Administration, materials manufacturers, packaging industries, suppliers and consumers); this means to apply a general approach that takes into consideration the overall life cycle of the packaging product thus avoiding the transfer of environmental impacts from one stage of the process to the next (Ecoembes 2003).

Finally, a comment on the problem of data availability. Although the data on packaging waste generation and management are easily available as it is mandatory for the EU member states to submit fact sheets and reports to the European Commissions for waste monitoring, the data about the different materials are collected by different entities and each of such entities uses a different data collection method. Thus, data availability depends on the type of material and the waste collection method.

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Correspondence (for further information, please contact):

Ángela Paneque de la Torre

Universidad Politécnica de Valencia. Departamento de Proyectos de Ingeniería.

Camino de Vera s/n. 42006. Valencia, Spain.

Phone: +34 96 387 7000 (ext. 75688)

E-mail: anpade@dpi.upv.es

URL : http://www.dpi.upv.es/id&ea/