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Waste Management in Germany – Development to a Sustainable Circular Economy?

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Abstract

The new German Closed Cycle Management Act is aimed to turn the waste management into a resource management. The realisation that waste can be a useful source of raw materials and energy is not new; metals, glass, and textiles have been collected before and put to new use. The waste management policy, which has been adapted in Germany over the past 20 years, is based on closed cycles and assigns disposal responsibilities to manufacturers and distributors of products. This has made people even more aware of the necessity to separate waste, led to the introduction of new disposal technologies, and increased recycling capacities. Today, 14 per cent of the raw materials used by the German industry are recovered waste. Modern closed cycle management contributes, with a share of approximately 20 per cent, to achieve the German Kyoto targets on the reduction of climate-relevant emissions.

Peer-review under responsibility of the organizing committee of 5IconSWM 2015

Keywords: Waste, Recovery, Recycling, Bio waste, Germany;

1. Introduction

The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety publish data and publications of the waste management in Germany. The following article will use these publications very closely to describe the waste situation in Germany (Jaron and Flaschentreher, 2012).

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The new German Closed Cycle Management Act (Kreislaufwirtschaftsgesetz, KrWG) is aimed to turn the waste management into a resource management. The realisation that waste can be a useful source of raw materials and energy is not new; metals, glass, and textiles have been collected before and put to new use. The waste management policy, which has been adapted in Germany over the past 20 years, is based on closed cycles and assigns disposal responsibilities to manufacturers and distributors of products. This has made people even more aware of the necessity to separate waste, led to the introduction of new disposal technologies**,** and increased recycling capacities.

Today, 14 per cent of the raw materials used by the German industry are recovered waste, thus leads to a reduction of the extraction levels and of the related environmental impacts. Modern closed cycle management contributes, with a share of approximately 20 per cent, to achieve the German Kyoto targets on the reduction of climate-relevant emissions.

Closed cycle management is not only a contribution to the environmental protection, it also pays off economically. The waste management industry has become an extensive and powerful economic sector in Germany: almost 200,000 people are employed in approximately 3,000 companies which generate an annual turnover of approximately 40 billion euro. 15,000 installations contribute to resource efficiency by recycling and recovery procedures. High recycling rates of approximately 60 per cent for municipal waste, 60 per cent for commercial waste, and 90 per cent for construction and demolition waste speak for themselves.

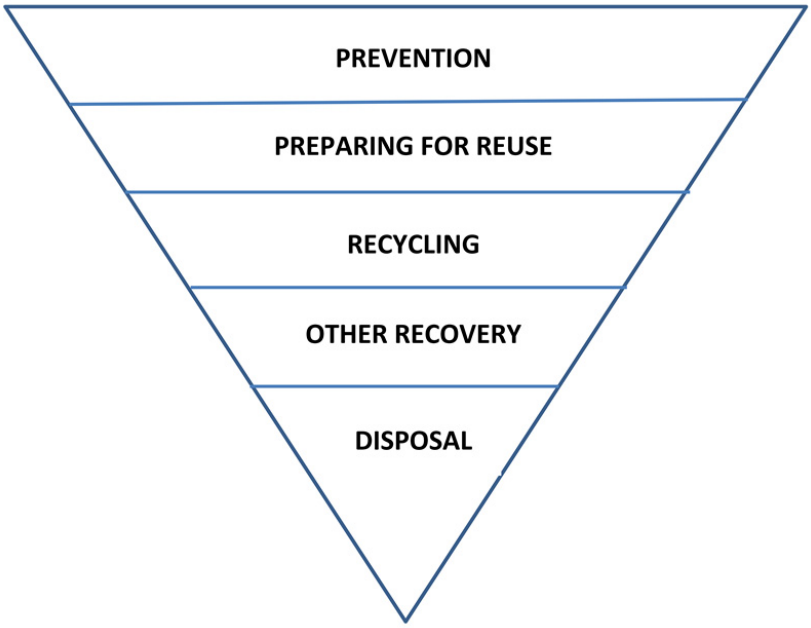

Fig. 1. Waste Hierarchy according European and German Law

Waste management was under a radical trans-formation since the early Seventies. At this time every village and town had its own tip (some 50,000 of them in total); today untreated domestic and commercial waste can no longer be deposited at landfill sites.

The European Union aims at the same conditions in the Member States. Both the living conditions and the methods of disposal are still quite different.

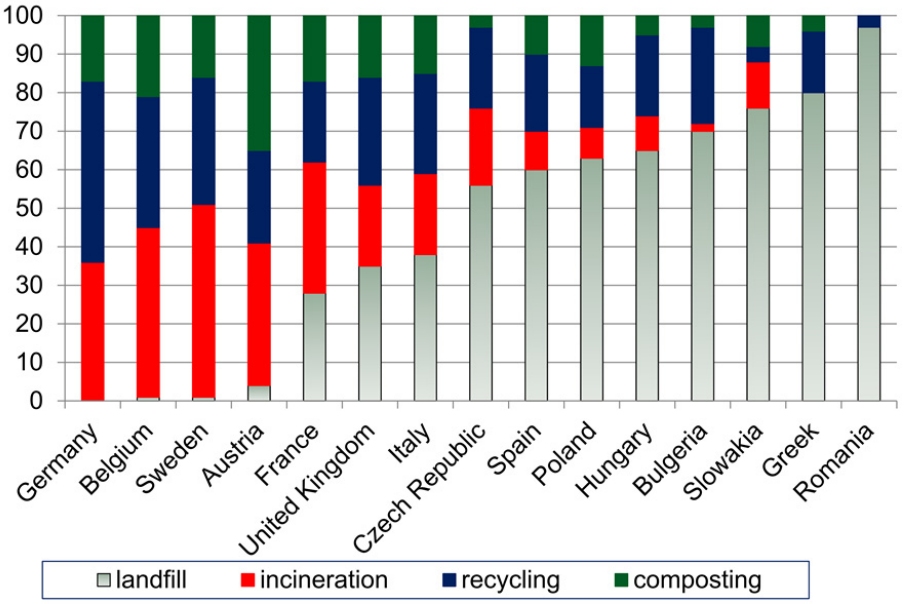

Fig. 2. Municipal Solid Waste treatment in selected EU countries (in%) (EuroStat 2015)

2. Waste Management Policy in Germany

Article 4 of the revised EU Waste Framework Directive (Directive 2008/98/EC) sets out five steps for dealing with waste, ranked according to the environmental impact – the "waste hierarchy".

The Waste Hierarchy gives top priority to preventing the creation of waste in the first place. When waste is created, it gives priority to preparing it for re-use, recycling, other recovery (such as energy recovery) and disposal (landfill after pre-treatment) in descending order of environmental preference.

The waste hierarchy has been transposed into German law.

A new obligation is included to draw up a national waste prevention programme (Article 33 KrWG). The programme formulates waste prevention targets, presents and evaluates existing waste prevention measures, and develops new measures on this basis. The aim is to strengthen waste prevention policies and make them more transparent to the general public. The Federal Ministry of the Environment formulated a waste prevention programme for the first time in 2013.

The Closed Cycle Management Act has also created the opportunity to introduce an obligatory, nationwide "uniform recycling bin". With this collection system, households should not only dispose of packaging but also other waste of the same materials, e. g. plastics or metal, in a new recycling bin. This means that recyclables from domestic waste can be collected in better quality and in larger quantities. It is proposed to regulate further details of the collection of recyclables in a separate law in the near future.

Since 1st of June 2005: wastes cannot longer be landfilled without pre-treatment! The pre-treatment takes place in incineration plants or mechanical-biological treatment plants. Waste must be treated so that it cannot degrade inside a landfill. Recoverable substances have to be separated before landfilling and the energy from the wastes have to be utilised.

Pre-treatment and stopping untreated landfilling protects our health and the climate. Landfills do not longer emit landfill gas – this gas contains methane and carbon dioxide.

Landfill-gas methane (CH_4) causes 21-25 times more damage to the climate than carbon dioxide (CO_2) (Greenhouse-Effect).

The emission of harmful leachate into the groundwater is one of the additional problems that the mankind has with landfills – waste pre-treatment leads to much better leachate qualities.

The German waste management system is totally financed by fees! No subsidies! There is a “polluter-pays” principle, means the producer has to pay for waste treatment or disposal.

Various groups of main stakeholders are working in waste management - municipal and private waste management companies (waste collection, recovery and disposal). Municipal waste management companies are responsible for bio waste and residual waste (domestic waste); private waste management companies are responsible for the waste recycling (domestic waste; trade waste, commercial waste).

3. Waste Arisings

The amount of waste currently produced is still too high. In particular in the field of municipal waste, further efforts towards a resource efficient consumption are needed to prevent waste from arising. The German waste prevention programme, launched in 2013, will contribute to develop advice, support, and incentive measures. 2013, there were only minor changes in the waste composition.

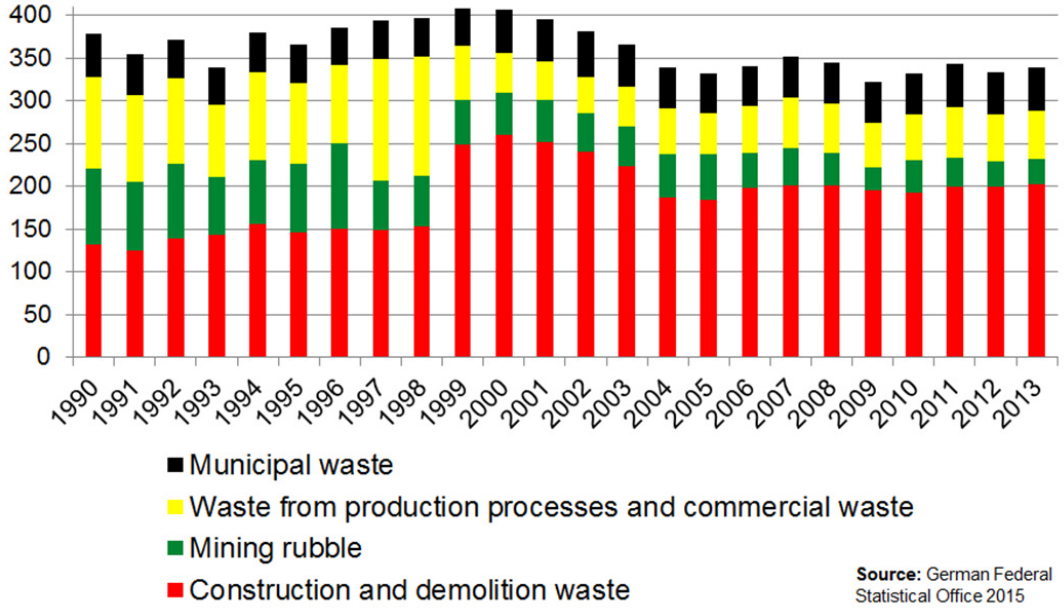

Fig. 3. Waste arising in Germany (in million tonnes) (BMU, 2015)

Overall, there were 339.132 million tons of waste; the recycling rate was 79 %. 202.735 million tons of construction and demolition waste (87 %); 57.577 million tons of waste from production processes and commercial waste (69 %); 29.250 million tons of mining rubble (1 %) and 49.570 million tons of municipal solid waste (87 %).

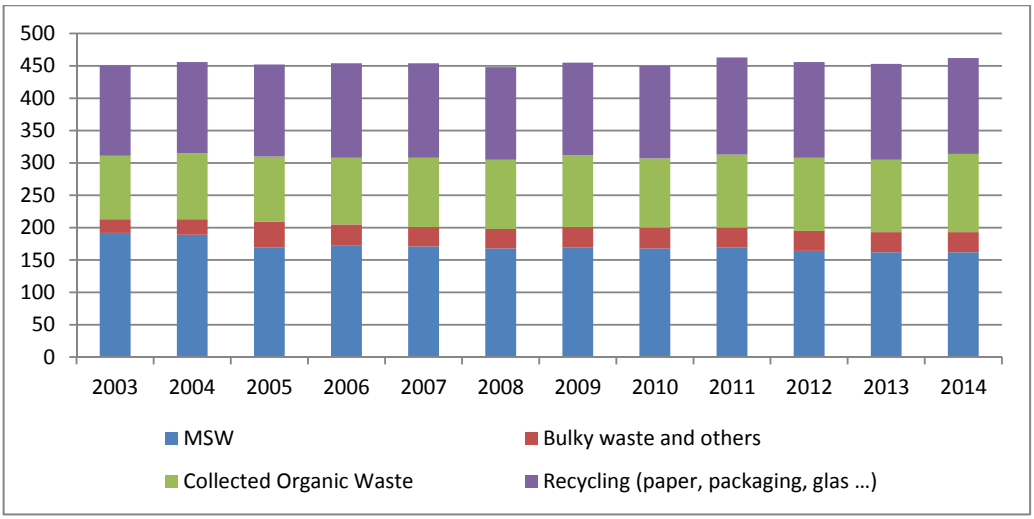

Fig. 4. Waste arising in Germany (in kg per inhabitant) (BMU, 2015)

In 2013 617 kg per inhabitant municipal waste including the share of household waste of 453 kg per inhabitant were produced in Germany.

4. Waste recovery and Waste disposal

The responsibility for packaging materials was already enforced in the Packaging Ordinance (VerpackV) in 1991. This ordinance has been amended various times in the recent years. It contains provisions on the obligation of producers and distributors to take back used packaging. In order to meet this obligation, retailers can participate in a system for the collection and recycling of the packaging materials. In 1993, a corresponding collection and disposal system was introduced in Germany. As a result, it was possible to significantly reduce the proportion of packaging in municipal waste.

Germany's waste recovery rates are one of the highest in the world and show how the waste industry contributes to sustainable economic production and management in Germany by saving raw materials and primary energy. The share of waste which cannot be recovered has to be consigned to disposal without inflicting harm on the environment or on human health. Organic waste always has to undergo mechanic-biological or thermal treatment to render it inert, thus helping to reduce drainage water leakages and releases of landfill gas. Since June 2005, it is no longer permitted to landfill organic waste without prior treatment. Around 70 waste incineration facilities with a capacity of 20 million tonnes are available in Germany for the treatment of residual waste. Moreover 4.6 million tonnes in incineration capacities are available in 30 refuse-derived fuel power plants. For the mechanic-biological treatment of waste, 44 facilities with a capacity of around 5.5 million tonnes are available.

4.1 Recovery of Waste Paper

Print products and paper for office and administration purposes are referred to graphic papers. The initiative of the Federal Environment Ministry Germany included a voluntary commitment in which a gradually increase of the recycling rate of graphic paper is fixed since 1994. Since 2001 Germany tries to keep the rate permanently at a level of 80 per cent (+/- 3 per cent). This pledge has been kept to date which is highly welcomed from the environmental perspective. Thus, the industry is clearly meeting the waste-related responsibility for its products. At the same time, this underpins the importance of waste paper recycling in the German paper producing industry and it contributes considerably to reduce the impacts on the environment.

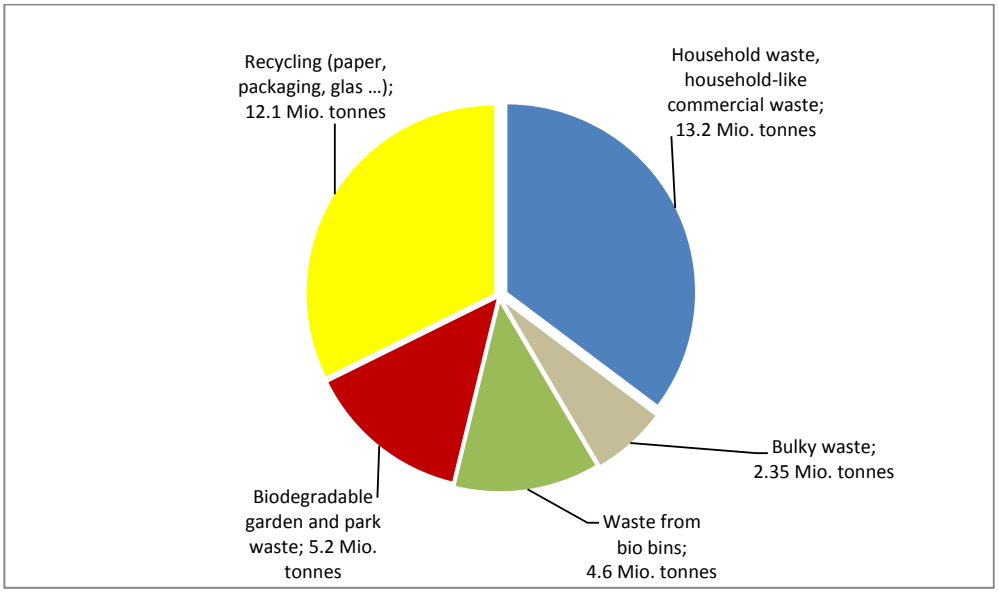

Fig. 5. Composition of household waste 2010 (in million tonnes)

4.2 Recovery of Packaging Materials

The most packaging is used to cover and protect food. Common packaging materials are glass, aluminium, tin plate, plastic, paper, cardboard, and wood – all of them valuable (secondary) raw materials which, if reused or recycled, can help to reduce the exploitation of natural resources, lead to energy savings and reduce the emission of greenhouse gases.

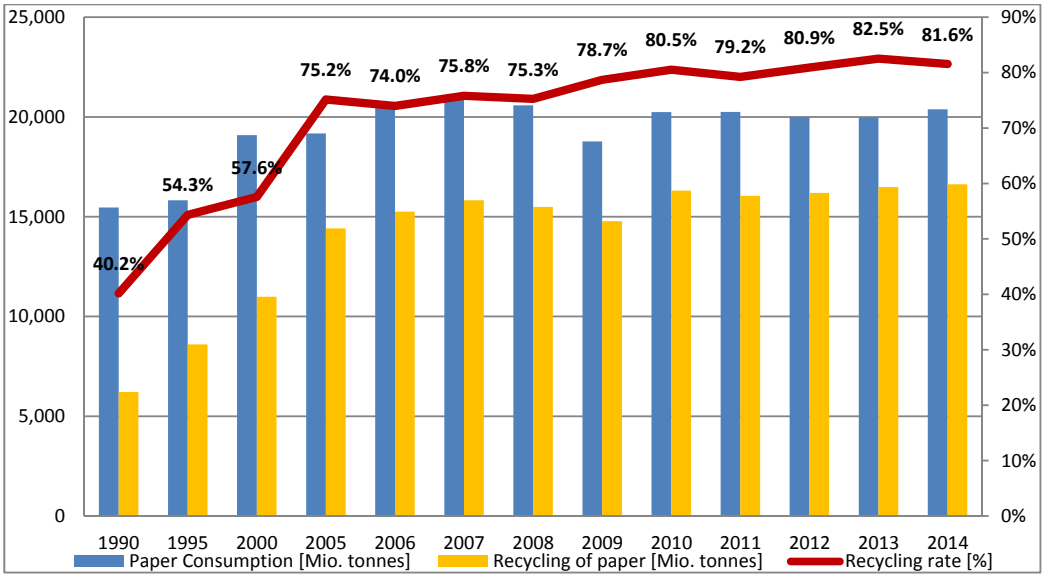

Fig. 6. Recycling of Waste Paper in Germany (1995 – 2014) (UBA, 2016)

The separate collection of packaging waste in households, introduced by the packaging ordinance, is supported with great commitment and widely followed by the population. In 2010, packaging waste achieved a total recovery rate of almost 85% in Germany. On average, every German citizen is already consigning almost 30 kg of waste per year to separate collection in yellow bins. In addition, waste glass packaging and waste paper/cardboard packaging is collected separately.

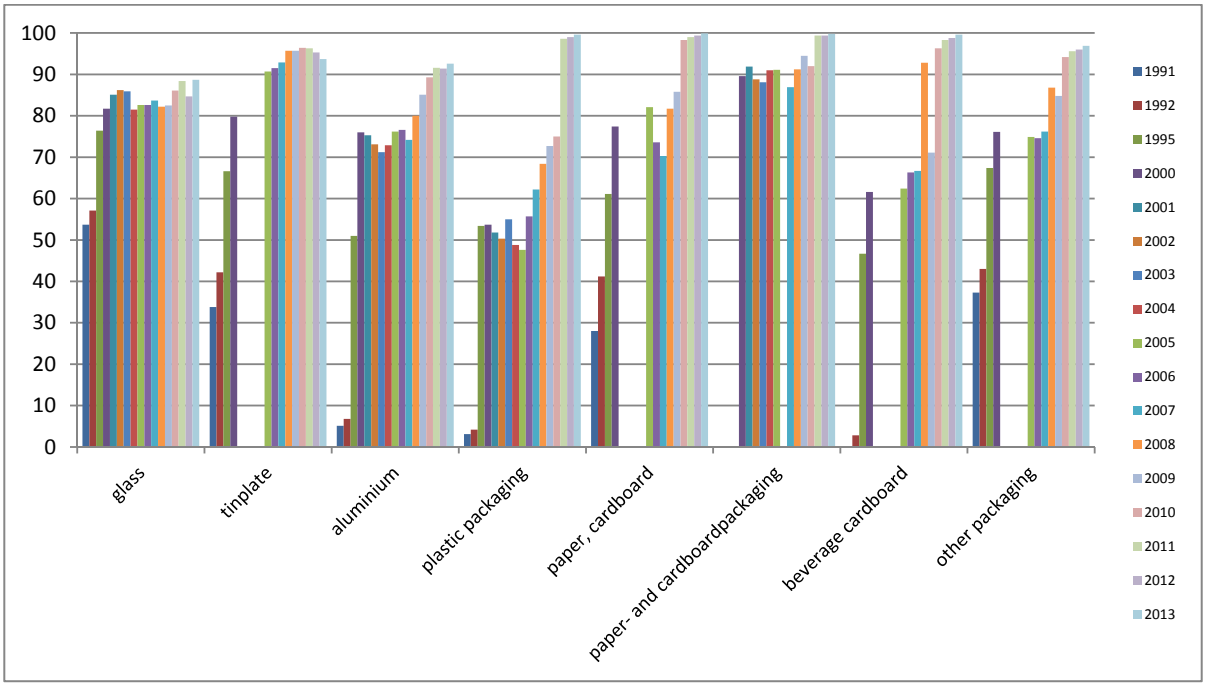

Fig. 7. Development of recovery rates of packaging waste between 1991 and 2013 (%)

4.3 Recovery of Bio waste

Around 12 million tonnes of biodegradable waste are treated yearly in composting and digestion plants (biogas installations) in Germany (mainly waste from the bio bin, biodegradable garden and park waste, market waste and other biodegradable waste of diverse origins). Around 9 million tonnes were collected separately, either via the bio bin (4.5 million tonnes) or as separately collected garden and park waste (4.5 million tonnes); this is equivalent to an average annual collection rate of 107 kg per citizen. Of the total bio waste volume, around 8 million tonnes were processed in 924 composting facilities and around 4.3 million tonnes were consigned to around 1,000 digestion plants. Around 3.55 million tonnes of compost and approximately 2.96 million tonnes of fermentation products for various purposes were produced from the collected bio waste.

The demand for high quality compost currently exceeds the supply. There is a good reason for this: compost or digestate produced from separately collected and treated bio waste can be used for fertilising (nutrients) and soil amelioration (humus). If bio waste, which is suited for the purpose, is consigned to digestion it is, moreover, possible to recover the energy generated. It is, for example, also possible to produce substrate mixtures for specific purposes from specially composted bio waste and soils. Concepts of this kind can play a significant role in the conservation of resources. Bio waste is also expected to make a larger contribution to energy generation in the future. Therefore, the amended Renewable Energy Sources Act (EEG) provides support when existing composting plants are supplemented with a fermentation phase. Process combinations of this kind generate both usable biogas and valuable compost which can be used for fertilisation and soil amelioration.

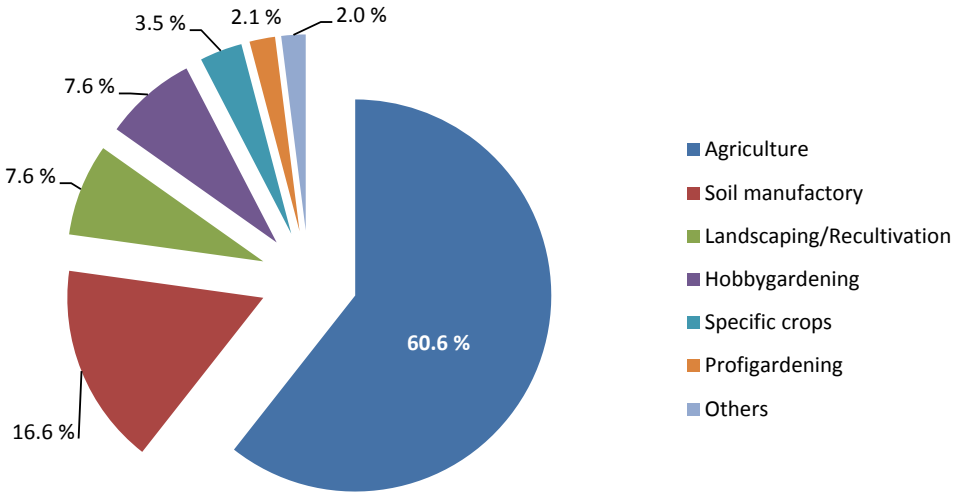

Fig.8. Use of Compost in Germany 2014 (German Compost Quality Assurance Association, 2014)

The most waste fractions are separately collected, the recycling quota are different. Not all waste fractions can be collected completely separately. Not all citizens use the collection systems for the various waste fractions. If a single waste fraction could be collected, it is also recycled to a very high percentage.

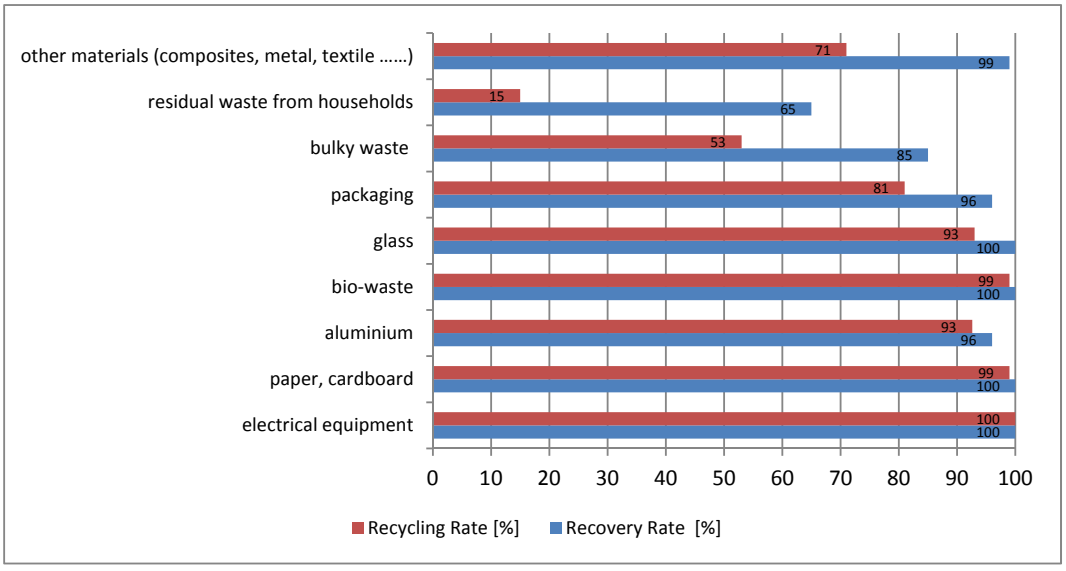

Fig. 9. MSW-Recycling Quota in Germany (2013) (coverage quota = collection rate)

The separate collection ensures a large amount of relatively clean waste. These separated fractions can then be recycled in various ways. More than two-thirds of household waste can be recycled.

Household waste (kg/person)	**462**
Residual waste	162
Bulky waste	29
Others (hazardous waste)	2
Recycled wastes (kg/person)	**271**
Waste paper	72
Bio waste (bio bin, green waste)	57 + 64
Waste glass	23
Lightweight packaging (aluminium, plastics, tinplate, composites)	33
Others (metals, electrical and electronical equipment, batteries)	20

Fig. 10. “Use” of household wastes (kg/person in 2014)

The collection of recyclable waste is well established in Germany. Nevertheless, there are always some problems to improve the quality of recovery. The proportion of recycling needs to be further increased. Too many high-calorific wastes are incinerated instead of material recycling.

5. Problems today and development tomorrow

Waste management in Germany is characterised by a good development in the last 40 years, but some problems are still on the table and some new problems are coming up. The prices for waste treatment vary greatly. Overcapacities of waste-treatment plants lead to falling prices. If plants are closed the treatment prices are regional rising. There are significant problems between the municipal and the private waste management companies (who will collect and recycle the recyclable wastes from households?). It arise always problems in financing the collection and recycling of waste from the yellow bin. These wastes are not funded by a waste fee. Since 1 January 2015, more recyclable wastes have to be collected and recycled. The transformation of the yellow bin (recyclable lightweight packaging) into a container for reusable materials is delayed since months. The nationwide collection of all organic wastes has not been realized yet. Still too many wastes are incinerated (thermal recycling) although material recycling would be ecologically beneficial.

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