

Review of plastic waste in municipal waste stream Germany



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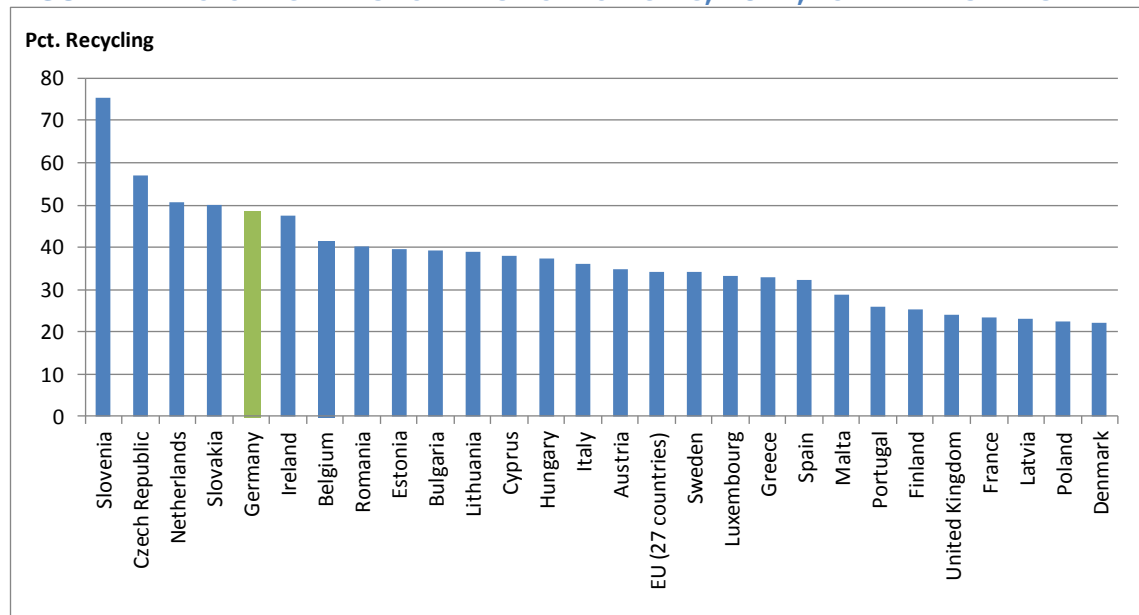
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1 INTRODUCTION

Data from Eurostat shows that Germany has the highest recycling rate of municipal waste; 270 kilo pr. capita in 2011 (Eurostat 2013). According to PlasticsEurope, Germany has a total demand on plastic on approximately 11,500 kilo tonnes in 2012, which equals to 143 kg. pr. capita and 33% of this is recycled (PlasticsEurope, 2013). When it comes to recycling of plastic packaging, the rate is also high; In 2011 the rate was 48.5% and even though it is a slight decrease from the previous year, there has been a general increase in the recycling rate since 2005 (Eurostat 2013).

FIGURE 1: RECYCLING RATES FOR PLASTIC PACKAGING, 2011, EU MEMBER STATES



Source; Eurostat 2013

Thus, Germany might be a good example for plastic waste sorting and collection and it is worth looking closer at the German conditions.

2 BRIEF DESCRIPTION OF THE WASTE MANAGEMENT SYSTEM

2.1 HOUSEHOLDS

Local authorities are responsible for the management of household waste.

In general, households are provided with a kerbside collection for four waste streams: paper and cardboard, lightweight packaging waste, biological waste and residual waste.

TABLE 1. KERBSIDE COLLECTION IN GERMANY

Blue bin (paper & cardboard)
- Envelopes, books, catalogues, illustrations, cartons, writing pads, brochures, writing paper, school books, washing detergent cartons without plastic, newspapers, paper boxes
Yellow bin or bags (lightweight packaging)
- Aluminum foil, plastic wrap, inside packaging materials
- Tins, cans, liquids refill sachets/bags, yogurt cups, body lotion bottles
- Plastic bags, margarine tubs, milk sachets, plastic packaging trays for fruit and vegetables, screw-top bottle tops, detergent bottles, carry bags, vacuum packaging, dishwashing liquid bottles
Brown or green bin (biological waste)
- Kitchen waste: old bread, eggs shells, coffee powder and filters, food leftovers, tealeaves and tea filters
- Fruit and vegetables: peels, apple cores, leaves, nutshells, fruit stones and pips, lettuce leaves
- Garden waste: soil, hedge trimmings, leaves, grass clippings, weeds, dead flowers, and twigs
- Other: feathers, hair, kitchen towels, tissues, sawdust, and straw
Grey bin (household waste)
- residual waste

Source: www.howtogermany.de

Waste glass is collected in a bring scheme and is often colour separated in clear, green and brown glass.

Households also have access to one or more recycling stations for bulky waste, electrical and electronic waste, hazardous waste and various forms of domestic, construction waste.

Producers and retailers have financial responsibility for the collection and management of packaging waste (incl. paper, glass and lightweight packaging), the households do not pay a waste fee for these streams. Instead, householders pay indirectly when they buy goods. Local authorities charge the households a waste fee for residual waste and biological waste, if they have the latter bin.

The German graphic papers working group (AGRAPA) made a voluntary commitment in September 1994 to recover 60 % of graphic paper by 2000. For several years the recovery rate has been above 85 %, (BMU 2011).

The first Packaging Ordinance was issued in 1991, and is presented in detail below.

The development of separate collection in Germany is shown in table 2.

TABLE 2. GERMANY: WASTE COLLECTED 1990, 2004 AND 2008

	1990		2004		2008	
	Percent	Tonnes	Percent	Tonnes	Percent	Tonnes
Residual waste	87	34 mio.	42	18 mio.	39	16.7 mio.
Waste for recycling:	13	5 mio.	58	26 mio.	61	26.5 mio.
• biowaste		√		√		√
• glass		√		√		√
• paper		√		√		√
• packaging		n/a		√		√

Source: Federal Statistic Office 2010, Federal Ministry for the Environment

2.2 PRIVATE ENTERPRISES

The local authorities may collect residual waste from private enterprises. Companies using the public collection scheme are mostly small enterprises and commerce in the city area.

In 1996, the amendment of the German Waste Act made private enterprises responsible for organising collection of the recyclable materials they generate (Weissenbach, 2007).

The German construction industry committed themselves to reduce the volume of recyclable construction waste being landfilled by half by 2005. In 2005, 70 % was recycled, (BMU 2011).

3 REGULATORY MEASURES ON PLASTIC WASTE

Back in the 1970s, authorities' environmental focus was mainly on pollution from landfills. Later, in the mid-1980s, focus shifted to diverting waste from landfills towards recycling and energy recovery. Today, focus is on efficient resource use and scarce resources.

In the mid-1990s, the Closed Substance Cycle and Waste Management Act (*Kreislaufwirtschaftsgesetz*) came into force, (BMU, 2011). The act has been amended in June 2012 to comply with the European Waste Directive and the five-level waste hierarchy.

The waste sector employs 250,000 people and has a turnover of 50 billion euros a year, (BMU, 2011).

3.1 PACKAGING – PRODUCER RESPONSIBILITY

In 1991, Germany was the first country to introduce a comprehensive system where manufacturers and distributors were made financially responsible for the packaging they created. Packaging waste had grown to around 30 % by weight of the total waste stream and 50 % by volume (Clean Production Action, 2003).

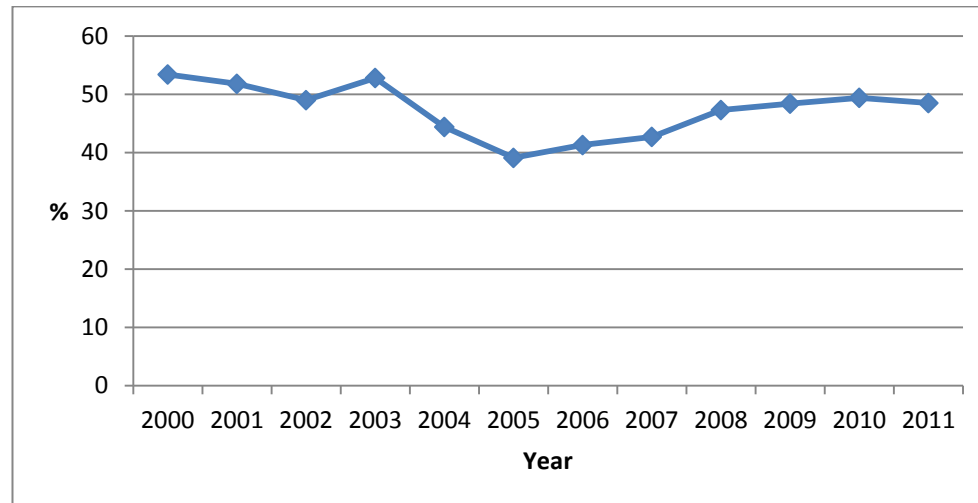
Requirements were set on the amount of packaging waste that manufacturers (fillers) and distributors (retailers) had to take back and recover, and these requirements increased gradually. This led to the creation of the Dual System Deutschland, DSD, in 1993, an organisation that collects and manages packaging waste according to the requirements on behalf of fillers and retailers. Companies pay a fee to the DSD which reflects the collection and recovery costs of the individual materials thus providing them with an incentive to reduce or minimise the packaging materials used.

In effect, the DSD had a monopoly status on the German market. However, in 2009 the Packaging Ordinance was amended to allow more producer responsibility systems to be established. Today, there are 10 producer responsibility systems in Germany.

Plastics are part of the lightweight packaging stream and is collected in a yellow bin or sack together with metals and drink cartons. Around 50 % of the lightweight fraction (yellow bins and sacks) from households is plastics (DKR website).

In 2009, almost 73% of packaging plastic placed on the market was recovered.

FIGURE 2: GERMAN RECYCLING RATES FOR PLASTIC PACKAGING



Source; Eurostat 2013

3.2 DEPOSIT – REFUND SYSTEMS

In 2009, 15 % of the plastics on the market was sold in recyclable plastic bottles, and another 2.6 % in ecologically advantageous beverage packaging, which includes beverage carton and stand-up pouch. As a result, the share of returnable and ecologically advantageous beverage packaging has been reduced to 52 %, (UBA 2011b). The other half was packed in recyclable plastic, glass bottles and cans.

Since 2004, one-way plastic packaging has increased from around 25 % of the market to more than 45 % (read from graph, UBA 2011b).

3.3 LANDFILL BAN

Germany has set limitations on the organic content of landfilled waste. The regulation has been implemented in two steps, first in 1993 with the TASI and in 2001 with the Waste Landfilling Ordinance (Weissenbach, 2007).

The TASI, technical instructions on municipal waste, requires that waste with a biodegradable content to be stabilised and inert. It sets a limit value on the organic content of waste going to landfill of 3 %.

However, the TASI had some loopholes, and so by June 2005, the Waste Landfilling Ordinance requires that waste has to be pre-treated prior to landfill. Pre-treatment include incineration and high-quality mechanical-biological treatment.

3.4 CHARGE OR FEE FOR MANAGEMENT OF MUNICIPAL WASTE

Traditionally, every household has to pay a fee for the municipal waste service.

In Hamburg, the fees depend on the size of the waste bin and the service frequency. The fees include most of the waste services (residual waste, paper waste, recycling yards etc.). Extra fees are charged for bio-waste and collection of bulky waste from the owner site. The fee structure is created to motivate the citizens to separate recyclable waste (no extra fee for paper waste, fee for bio-waste only 20 % of fee for residual waste). The fee amount depends to the size of the residual waste bin. Additionally, all households have to pay a basic fee (for infrastructure, recycling-yards etc.). The monthly waste fee for a household in a multi-storey building with 10 flats is shown in table 6 (below).

3.5 HIGH RECYCLING TARGETS FOR WASTE PLASTIC

The German packaging ordinance demands targets only for packaging used by private consumers (households): 60 % of the production should be collected, hereof 60 % for recycling, which means the recycling target is 36% of the plastics placed on the market for private consumers. Therefore, the targets are not directly comparable with the EU targets. The EU targets were reached.

4 COLLECTION SCHEMES AND QUANTITIES COLLECTED

This chapter is dedicated to convey information about a single example on a German collection scheme; an expansion of the lightweight packaging to a recycling bin.

4.1 THE RECYCLING BIN OR “GELBE TONNE PLUS” OR “WERTSTOFFTonne”

In September 2011, the Federal Environment Agency recommended that the yellow bin should be upgraded to a dry recycling bin (UBA, 2011a). In addition to packaging, the recycling bin should contain everyday items made of plastic and metal. Non-packaging items are for example toys, cutlery, pots, pans and plastic buckets. Moreover, many citizens already used the yellow bin/sack for non-packaging items. The aim is to increase the amount of recyclable materials collected by 7 kg per capita per year.

The agency finds that the bin should not contain waste from electrical and electronic equipment as it might contaminate the other materials with heavy metals and fire-proofing agents.

The financing of the initiative is still to be decided upon. Two models have been developed. In model A, all responsibility and financing is placed with the private sector. In model B, the responsibility for organising the waste collection lies with the municipalities, while the financing is shared, so the light packaging will be financed by the manufacturers and suppliers as today, and the non-packaging items will be financed via a waste charge.

The recommendation from the agency is based on results from a pilot project. Several municipalities and federal states (Länder) have conducted pilots. In addition to equivalent non-packaging materials, various combinations of materials accepted in the recycling bin have been tested. For example, Berlin includes electronic devices, wood and textiles in the recycling bin but not lightweight packaging. Hamburg on the other hand, accepts only lightweight packaging and non-packaging made of plastic and metal.

TABLE 3. COMPARING THE RANGE OF MATERIALS ACCEPTED IN SELECTED CITIES

Materials	Berlin	Hamburg	Leipzig	Dortmund	Hannover
Equivalent non-packaging materials (metals, plastics and composite materials, e.g. pans, watering cans, toys)	+	+	+	+	+
Electronic devices	+	-	+	+	+
Wood	+	-	-	-	-
Textiles	+	-	-	-	+
Lightweight packaging	-	+	+	+	-
Increase in the collected amount: 5 – 13 kg per capita per year					

Source: Noguera (2012)

In Leipzig, a pilot was initiated in September 1994 (Bünemann et al., 2011). The partners in the pilot were the SERO Leipzig GmbH, a cooperative initiative of the city of Leipzig, the Abfall-Logistik Leipzig GmbH and Duales System Deutschland

GmbH, (DSD website). The outcome of the project was successful and the partners agreed to continue the system on regular terms. In the pilot, the collected amount increased by 7.7 kg/capita where 3.1 kg/capita was plastic and metal.

A pilot was made in selected areas of Berlin from September to December 2004 where the orange box or Yellow Bin Plus was tested among 5,000 households (Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz, 2009). During the pilot, the residual waste volume was reduced by 19 % and the collected amount of dry recyclables increased from 15.6 to 22.8 kg per inhabitant, or 7.2 kg/inhabitant. Of the additionally collected waste, 4.4 kg was metal and plastic.

In Hamburg, two pilot areas were selected: Hamburg-Langenhorn where the pilot ran for about 21 months (June 2006 – February 2008), and in Hamburg-Wilstorf und Hamburg Kirchdorf-Süd where it ran from October 2007 till June 2008 (Bünemann et al., 2011).

An interesting result from the pilots is that in addition to the collection of same-material non-packaging, more lightweight packaging was collected in the new scheme.

TABLE 4. MATERIALS COLLECTED IN LEIPZIG, BERLIN AND HAMBURG IN PILOTS

	Leipzig Yellow Bin Plus		Berlin Yellow Bin Plus		Hamburg Recycling Bin	
	Kg/capita	Percent	Kg/capita	Percent	Kg/capita	Percent
Before change of system						
Lightweight packaging	14.4	56.0	6.1	39.3	10.5	66.5
Other metal & plastic	3.5	13.4	1.9	12.3	1.6	10.1
Other items	7.9	30.6	7.6	48.4	3.7	23.4
Total	25.8		15.6		15.8	
After change of system						
Lightweight packaging	15.3	45.6	8.4	36.8	13.8	63.9
Other metal & plastic	5.7	17.0	4.0	17.5	3.3	15.3
Other items	12.5	37.3	10.4	45.6	4.5	20.8
Total	33.5		22.8		21.6	
Increase in collected amount of LWP, plastic & metal						
Lightweight packaging	0.9		2.3		3.3	
Other metal & plastic	2.2		2.1		1.7	
Total	3.1		4.4		5.0	

Source: Bünemann et al. (2011)

4.1.1 Hamburg

The general trend in Hamburg, as well as in many other German federal states, is that more waste is separated for recycling and less residual waste is incinerated with energy recovery. Landfilling of residual waste terminated in 1999.

TABLE 5. HAMBURG: HOUSEHOLD WASTE COLLECTED 1990, 2000 AND 2012

	1990		2000		2012	
	Percent	Tonnes	Percent	Tonnes	Percent	Tonnes
Residual waste	88	625.000	72	586.000	68	479.000
Waste for recycling:	12	86.000	28	226.000	32	223.000
• biowaste	(√)		(√)		√	
• glass	√		√		√	
• paper	√		√		√	
• packaging	n/a		√		√	

Source: Hamburg State Ministry of Urban Development and Environment (BSU)

In 2009, the City of Hamburg introduced a new “recycling campaign” which was activated in January 2011 through a Recycling-Ordinance with a revised fee-structure: “Separate to save”. The initiative re-launched the four-bin system:

- green bin for bio and garden waste
- blue bin for paper and cardboard
- yellow bin for lightweight packaging and other items of plastic and metal
- grey bin for residual waste.

BOX 1: THE CONTENT OF THE NEW YELLOW BIN IN HAMBURG

- Drinks and milk cartons
- Plastic packaging (bottles, films, bags)
- Plastic objects (bowls, buckets, toys)
- Cans and tubes
- Aluminium foil, aluminium bag and pet food bowls
- Metal items (pots, pans, tools)

The city had aimed at some ambitious collection waste targets for 2012, which for plastic, metals and packaging was 39.700 tonnes. They did not meet this, but they did collect 32.800 tonnes and it constitutes an improvement of 5,100 tonnes of extra collected of plastic, metal and drink cartons compared to 2007 level.

With the re-launch, the yellow bin was upgraded to a recycling bin where citizens could get rid of other items than just packaging. It is an advantage that the yellow bin is a well-known system already, and that there is no need for investing in new bins or finding space for an extra bin in the back yards all ready equipped. The recycling bin was introduced in all of Hamburg in May 2011.

The yellow bin is financed by the city (Stadtreinigung Hamburg) who pays for the treatment of the non-packaging waste in the bin and a share of the collection costs. The dual systems for packaging still pay municipalities for information and access to infrastructure, they arrange logistics and pay for it, and they get the materials after sorting and they sell it on the market.

By January 2011, Hamburg also revised the fee structure for private households. The fee for the green biowaste bin was reduced by around 70 %, and the fee for the grey residual bin was increased by around 4 %. There is no bin-bound fee for the households for the blue (paper) bin. The costs for collection and recycling are paid by the Stadtreinigung for the not-packaging paper (the costs are covered by the basic fee, every household has to pay (see 3.4)) and by the producers in the packaging producer responsibility systems (see 3.1)). Also the yellow bin is free of a direct bin-bound fee for the households. The costs are splitted following the same principle as above. The packaging collection systems pay for the packaging waste (paper/cardboards, plastics and metal), the Stadtreinigung pays (money from the basic fee) for the not-packaging paper, plastics and metal.

Use of the 12 recycling stations is free (or covered by the waste fee) for bulky waste, and other recyclables. If households bring heavy and expensive waste streams, such as construction waste, asbestos or waste oil, there is a fee¹.

The monthly waste fee for a household in a multi-storey building with 10 flats is shown in table 6.

TABLE 6. HAMBURG: MULTI-STOREY BUILDING WITH 10 FLATS, EURO

Monthly fee per flat	Fee before 1.1.2011	Fee from 1.1.2011
Waste volume: 102 litre per week (excluding packaging)		
1,100 litre residual waste bin, weekly collection (1/10)	10.17	
500 litre residual waste bin, weekly collection (1/10)		6.87
240 litre biowaste bin, weekly collection (1/10)		0.48
240 litre paper and cardboard bin, weekly collection		0.00
1,100 litre "yellow bin", collection every two weeks	0.00	0.00
Basic fee	6.15	6.56
Total waste fee per flat	16.32	13.91
Change		-2.41

Source: Stadtreinigung Hamburg.

¹ For an overview to the fee amounts look at <http://www.srhh.de/srhh/opencms/privatkunden/gebuehren.html>

Between May and December 2011 the share of non-packaging materials collected in the recycling bin was around 12.5 % of the total amount of packaging and non-packaging materials in Stadtreinigung Hamburg. Around 54% of the collected materials are plastic. 11 % is flexible plastic/foils and 9 % rigid plastic to recycling. The additional amount is 35% mixed plastic which is used for energy recovery.

The collected amount of plastic per capita in 2011 was 20.7 kg/head (incl. commercial generators; only households-packaging 6.5 kg/head).

4.1.2 Berlin

In 2010, Berlin generated 1.26 million tonnes of household and commercial waste. Of the 858,000 tonnes destined for incineration, 703,000 tonnes is from households and 155,000 tonnes is from commerce.

A sorting analysis of the two streams showed that they comprised a large share of recyclables. Plastics are about 7 % of the residual household waste and 9 % of the residual commercial waste. This analysis shows, that there is a potential for increasing the recycling level.

TABLE 7. BERLIN: WASTE COMPOSITION OF WASTE IN THE RESIDUAL/GREY BIN, PERCENT

Materials	Household waste (2010)	Commercial waste (2010)
Plastics	6.6	8.9
Metals	2.1	2.3
Paper/cardboard	11.4	15.0
Glass	6.8	3.9
Organic matter	41.9	45.2
Compound	9.1	10.5
Textiles	3.6	1.6
Mineral material	2.1	1.9
Wood	0.3	0.8
Other	16.1	9.9

Source: Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz (2010)

The Yellow Bin Plus from the pilot project has been introduced gradually in Berlin. In 2007, 21 % of the population was able to use the bin, (Senatsverwaltung für Gesundheit, Umwelt und Verbraucherschutz, 2009).

The Yellow Bin Plus was renamed to the Orange Box and by January 2011, all households in Berlin had access to the orange box placed on either private ground (kerbside collection) or in public areas (bring scheme).

The scheme has been evaluated and the results show that a total of 13 kg was collected from every citizen. The share of plastics for recycling was 0.9 percent.

BOX 2: WHAT THE ORANGE BOX IN BERLIN CONTAIN

- Plastics: Household items such as plastic bowls, buckets, watering cans, molded parts, plastic covers, flower pots, plastic toys
- Hair dryers, toasters, radios, MP3 / CD players, Gameboys, telephones, cell phones, keyboards, smaller printers
- Toys: Wood, plastic and electric toys
- Metals: Household items made of metal and iron goods such as pots, pans, cutlery, metal tools, screws, nails, pieces of wire, pipe sections, sheet remains
- Disk media such as CDs, DVDs and floppy disk
- Textiles (in bags): No more portable and old clothing, lingerie, home textiles such as towels, curtains, bed linen and fabric scraps. Please no shoes.
- Waste wood.

TABLE 8. BERLIN: RESULTS OF THE EVALUATION IN 2010-2011

Materials	Kg	Percent
Equivalent non-packaging materials (metals, plastics and composite materials, e.g. pans, watering cans, toys)	4	31
Electronic devices	2	17
Wood / bulky waste	3	20
Textiles	1	8
Lightweight packaging	1	9
Other (wrong sorted)	2	15
Total	13	100

Source: Noguera (2012)

So far, 46 % of the materials collected in the orange box is recycled while 54 % is incinerated with energy recovery (Table 9).

TABLE 9. BERLIN: RECYCLING AND ENERGY RECOVERY OF THE ORANGE BOX MATERIALS, PERCENT

Materials	For recycling	For energy recovery
Plastics	0.9	
Metals	11.7	
Paper/cardboard	0.5	
E-waste	13.7	
Wood (untreated)	11.8	
Mineral material	7.1	
Treated wood		2.9
RDF		51.4
Total	45.7	54.3

Source: Noguera (2012)

The orange box is not supposed to contain packaging as packaging is to be collected as usual in the yellow bin/sack. However, from January 2013 the city will merge the yellow bin and the orange box so citizens only will have one recycling bin (Senatsverwaltung für Stadtentwicklung und Umwelt, 2011).

5 BACKGROUND INFORMATION

5.1 STRUCTURE OF ADMINISTRATION

Germany is a Federal Republic with 16 Federal States, each with their own constitution. The states are composed of 403 districts and can be further subdivided into municipalities.

The responsibility for waste management is divided between national Government, the Federal States and local authorities. The Ministry of Environment sets the general priorities for waste facilities. The development of waste management planning is a responsibility of the Federal State, which adopts its own waste management act containing supplementary regulations to the national law (EEA, 2009).

FIGURE 3: MAP OF GERMAN FEDERAL STATES



5.2 GDP PER CAPITA

GDP per capita in 2011 was EUR 31,437, which is a slight growth compared to the previous year.

5.3 OCCUPATIONAL STRUCTURE

The labor force is divided as follows; agriculture; 2.4%. Industry; 29.7%. Services; 67.8%. GDP by sector in 2011 is divided as follows; agriculture: 0.8%, industry: 28.6%, services: 70.6%.

TABLE 10. BACKGROUND DATA ON POPULATION DENSITY AND NUMBER OF HOUSEHOLDS

	Berlin	Hamburg	Country
Population	3.5 million	1.8 million	80.548 million
Number of households	2 million*	930,000**	40,076 million***
Population density	3,800/km ²	2,400/km ²	235,5 /km ²

Notes: * Around 83 % of the citizens live in rented homes. ** 80 % of inhabitants are living in flats / multi-storey buildings. *** 2008

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