Waste Policy for Source Separation in Germany

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Abstract There is global consensus for developing a circular economy and building green societies. As the two leading countries in their regions in this field, both China and Germany want to reduce the environmental impacts of waste and avoid the programme of "NIMBY" and have accumulated much experience in waste reduction and gradient utilisation of waste. "Pay As You Throw", "Green Dot" system and "trade in policy (the new for old policy)" have all proven to lead to higher recycling rates and the minimisation of waste in the past 30–40 years. The article shows how German waste legislation developed to achieve the actual recycling rates. Though Germany follows the European laws, above this it has set a number of even stricter requirements, which are summarised in this paper. The main strategies for implementing source separation are described, while potentials are detected for certain waste fractions like plastics and textiles.

Keywords Circular Economy Act, Recycling rates, Source separation, Waste legislation, Waste policy

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R. Maletz et al. (eds.), *Source Separation and Recycling*,
Hdb Env Chem (2018) 63: 3–10, DOI 10.1007/698_2017_114,

1 Introduction: Situation in Germany

German industries have shouldered the voluntary commitment for conserving resources and avoiding waste, reinforced by obligations for returning and recovering recyclables such as glass, packaging material, metals, etc.

From 1992 to 2004, there was average economic growth of 15%. Besides that, the total volume of domestic waste remained basically the same. The recovery of municipal waste had been increased to 63% up until 2013 (Table 1). German industries have shouldered the voluntary commitment for conserving resources and avoiding waste, reinforced by obligations for returning and recovering recyclables.

As for end-of-life vehicles, batteries and electrical wastes, states are obligated to separately collect and recover containing toxic substances. In Germany, municipal waste has been defined as, "waste from private households and similar institutions, as well as domestic-type waste produced by trade and industry."

The current situation of waste management in Germany can be summarised in three phases: "return and recovery", "waste management" and "waste disposal." German industries have shouldered the voluntary commitment for conserving resources and avoiding waste, reinforced by obligations for returning and recovering recyclables such as glass, packaging material, metals, etc. As for end-of-life vehicles, batteries and electrical wastes that contain toxic substances, states are obligated to collect and recover them separately. In Germany, municipal waste has been defined as "waste from private households and similar institutions, as well as domestic-type waste produced by trade and industry." Municipal waste includes household waste, separately collected recoverable materials such as glass and paper, packaging waste, organic waste and bulky waste (Fig. 1).

2 Legal Principles of the EU and Germany

In Germany, the Circular Economy Act was installed within the last few years. The EU Waste Directive 2008/98/EC [2] sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling and recovery.

Table 1 Collection of valuables in the years 1990–2014 [1]

Year	Valuables	Residual waste
1990	5 Mio. Mg, 13%	34 Mio. Mg, 87%
2004	25 Mio. Mg, 58%	18 Mio. Mg, 42%
2008	26 Mio. Mg, 61%	17 Mio. Mg, 39%
2014	29 Mio. Mg, 63%	16 Mio. Mg, 37%

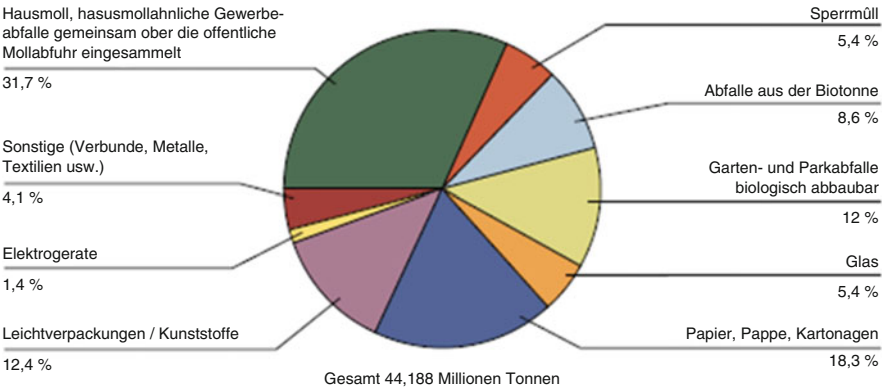

Fig. 1 Waste composition in 2015, derived from DESTATIS [1]

Furthermore, the directive explains when waste ceases to be waste and becomes a secondary raw material (so-called end-of-waste criteria) and how to distinguish between waste and by-products. The directive lays down basic waste management principles by preventing or reducing the adverse impacts of the generation and management of waste and by reducing the overall impacts of resource use and improving the efficiency of such use. In addition, it requires that waste has to be managed without endangering human health and harming the environment.

Most of the single requirements from the WFD [2] have been transposed "one to one" into national legal requirements and are hence included in the German Circular Economy Act [3].

The directive stipulates that waste legislation and policy of the EU member states shall apply as a priority order in the following waste management hierarchy:

1. *Reduce*: Reduction is the best way to manage solid waste and encompasses all manufacturing aspects such that waste is not created or is kept to a minimum by the waste producer – closely tied to the producer and to the consumer.
2. *Reuse*: Reuse is the better way to manage solid waste and will usually represent an environmental gain – in most cases it will use far less energy than recycling.
3. *Recycle*: Recycling is a good way to manage solid waste and keep items out of landfills and conserve natural resources. The goal of every recycling process is to use or reuse materials from garbage in order to minimise the amount of solid waste. Options include separation, mechanical and thermal treatment.
4. *Recovery*: Recovery includes processes like anaerobic digestion and incineration with energy recovery and other processes which produce energy and also some backfilling operations.
5. *Disposal*: Disposal means processes to dispose of waste without energy recovery such as landfilling and incineration.

2.1 Waste Avoidance

The principle of producer responsibility is embedded in the EU legislation. The Circular Economy Act includes regulations for product responsibility (§§23 ff., [3]) for the further development of the Packaging Ordinance to a uniform household-oriented recycling of valuables.

Caused by the need for the increase in resource efficiency, instruments of waste avoidance will be developed dynamically and continuously. Waste avoidance programmes are to be drawn up. Waste prevention targets need to be formulated; existing waste prevention measures will be compiled and evaluated. By that, new measures have to be developed. This is intended to strengthen waste prevention policies and make them more transparent to the public.

2.2 Improve Resource Efficiency

In order to improve resource efficiency, some additional requirements are defined in the German Circular Economy Act.

The following paragraphs in the Circular Economy Act [3] show the additional requirements:

2.2.1 §11 Recycling for Biodegradable Waste and Sewage Sludge

1. Biodegradable waste has to be collected separately, beginning with the 1 January 2015.

2.2.2 §14 Promotion of Recycling and Material Recovery

1. For the purpose of proper, safe and high-quality recycling, paper, metal, plastics and glass wastes are to be collected separately from 1 January 2015 at the latest, as far as is technically and economically practicable.
2. Preparation for the reuse and recycling of municipal solid waste is expected to total 65% w/w on 1 January 2020.
3. For construction and demolition, a waste recycling rate of at least 70% will be achieved.

These quotas ensure the national successes of the cycle economy and provide impulses for further development. The quotas, which are partly above the EU targets, take into account both the existing recycling level in Germany and the economic feasibility.

2.2.3 §9 and 15 Promotion of Separation and Collection

Recycling is promoted by separation and separate collection of different waste streams. Besides the existing demands ([3], §15) now, in addition, for hazardous waste, the mixing ban is implemented in KrWG [3], §9.

However, some requirements are "not included", i.e. the KrWG [3] does not ban the mixing of waste with other waste with other properties (article 10(2)) when collecting. Furthermore, the KrWG [3] does not include the restriction of separate collection if this is environmentally practicable (article 11(1)) and therefore goes beyond the WFD, by not including this possibility for derogation. Further, the requirement that separate collection has to be appropriate to meet the necessary quality standards for the relevant recycling sectors is not included (article 11(1)). "Additionally", the KrWG [3] includes an obligatory requirement for the separate collection of biowaste (Art. 22, WFD 2008), including an exact deadline for implementation (1 January 2015).

2.2.4 Main Strategies Implementing Separate Collection

Germany is a federal republic consisting of 16 federal states, and the responsibility for waste management and environmental protection is shared between the national government, the federal states and local authorities.

The National Ministry of the Environment sets priorities; participates in the enactment of laws; oversees strategic planning, information and public relations; and defines requirements for waste facilities.

Each federal state adopts its own waste management act containing supplementary regulations to the national law, e.g. concerning regional waste management concepts and rules on requirements for disposal. There is no national waste management planning in Germany. Instead, each federal state develops a waste management plan for its area.

Paper, metal, plastic and glass waste, as well as biowaste, shall be collected separately at the latest from 1 January 2015.

The Packaging Ordinance [4] transposes the requirements of the EU directive on packaging and packaging waste into national law and provides requirements for separate collection and specific targets for recycling and recovery of packaging waste.

The stepwise implementation of the Packaging Ordinance had the following milestones [5]:

- At the latest by 31 December 2008, a minimum of 65% by weight of packaging waste must be recovered, and a minimum of 55% by weight of packaging waste must be recycled.
- For packaging from private households, the following recycling rates are demanded: plastics 36%, composite materials 60%, glass 75%, tinplate 70%, paper and cardboard 70%, aluminium 60%.

– Product responsibility for the waste management of packaging either as placing takeback opportunities in the markets, reusing or recycling the packaging or paying for a third party.
– Implementation of recycling bins for plastics and metals in order to increase recycling.
– Existing yellow bins (for packaging) can also be used for so-called non-packaging of similar material.
– Ongoing discussion about a new law for recyclable material.

The performance of the development of recycling performance in Germany (DE EEA 2013) can be summarised that recycling has increased from 48% of MSW generated in 2001 to 62% in 2010. The EU target of 50% recycling by 2020 has already been met; there was no increase in the recycling level of MSW between 2006 and 2010, whereas incineration has increased (DE EEA 2013).

3 Realisation of Legal Principles

3.1 Case Study: Waste Paper

In the last 20 years, the amount of separately collected waste paper increased significantly. Comparing the collection of the last 20 years, there is an increase of the use of waste paper as a secondary raw material and the decrease in the amount of waste paper in the residual waste.

In 2013, roughly 22.4 million Mg paper was produced mainly based on natural resources like wood, recovered fibres and minerals in Germany (VDP 2014). In Germany and worldwide, recovered paper is the most important raw material for the paper industry. Nowadays, resources, products and waste materials are reused or recycled. With a recovered paper utilisation rate of 74% (D 2013), the paper industry is on the way to a circular economy. The products are used again and again as secondary fibrous raw material after their first and second use phase. Table 2 shows the paper for recycling balances in Germany over the last 20 years [7].

Table 2 Comparison of paper balances in Germany in 1992 and 2011 [6]

Recovered paper	Unit	1992	2011	Change (%)
Paper/cardboard production	Mio. Mg	12.941	22.706	75
Recovered paper: end consumer	Mio. Mg	12.268	16.677	36
Nonrecyclable recovered paper: end consumer	Mio. Mg	0.687	1.880	174
Separately collected/recovered paper in household and commercial	Mio. Mg	6.785	13.846	104
Recovered paper in the waste management system	Mio. Mg	5.483	2.831	−48

Caused by a high amount of paper use in households as well as in small and medium enterprises, a high amount of waste paper occurs. Paper production increased from 1990 until 2011 from 12.8 Mio. t to 22.7 Mio. t. Waste paper utilisation increased from 49 to 71%. Due to the extended demand on waste paper, the separate collection of waste paper was continuously increased by different systems.

3.2 Case Study: Biowaste

Actually, in Germany an average of 100 kg biowaste/cap/a are collected separately.

Caused by the legal requirements of the Circular Economy Act [3], especially by 11/1, a further increase of the separate collected amount of biowaste is expected.

Regarding Kern et al. [8], more than 50% of people have no separate biowaste bin. In 72 of 388 municipalities, no biowaste bin is offered. In the municipalities that offer a biowaste bin, not all people have access to the separate collection of biowaste (Table 3).

There are different utilisation pathways of not separately collected biodegradable waste, such as home composting, collection as residual waste and illegal disposal in forests or in the countryside.

Approximately 10 kg of biowaste/cap/a will remain in the residual waste also by implementing a nationwide separate collection of biowaste. In addition, we will not mobilise the biowaste, as it is home composted. In some rural areas, separate collection is environmentally and economically not practicable.

4 Summary and Outlook

In Germany within the last several years, we considered a declining amount of residual waste by increasing the collection of organic and recyclable material.

Recycling is already well-established in the fields of paper and glass. Waste paper and waste glass are the most important raw materials for paper and glass production. But there are other potential valuables for recycling deducible, such as textiles and plastics, whereas the recycling rates need to be increased in order to reach the demands from the EU.

Table 3 Access to separate collection of biowaste [8]

Access to biowaste bin	Municipalities	Inhabitants	Municipalities (%)	Inhabitants (%)
Biowaste bin nationwide	281	62,834,634	72.4	76.9
Biowaste bin in subsections	35	8,323,282	9.0	10.2
No biowaste bin	72	10,525,917	18.6	12.9

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