

Comparison between German (Hamburg) and Italian (Turin) WEEE management systems

Hobohm J.^{1,*}, Kuchta K.¹, Caiani S.² and Fiore S.²

¹TUHH, Hamburg University of Technology, IUE; Harburger Schloßstr.36, 21079 Hamburg, Germany

²DIATI, Politecnico di Torino – corso Duca degli Abruzzi 24, 10129 Torino, Italy

*corresponding author:

e-mail: Julia.Hobohm@tuhh.de

Abstract

In the world about 30-50 Mt/y of WEEE is disposed and often improperly managed, leading to potential negative environmental impacts and to a loss of secondary raw resources. The aim of this paper is the assessment of WEEE management systems in Germany and Italy, as representative examples of EU countries. A specific comparison was made between Hamburg (1.7 M inhabitants) and Turin (2.3 M inhabitants) metropolitan areas. The analysis highlighted analogies (collection targets, national coordination centers and producer responsibility) and differences (e-waste classification and collection systems). Improvements in the collection phase are necessary in both countries in order to fulfill Directive 2012/19/EU targets. While large e-waste showed the highest collection rate, about IT, small household and consumer equipment e-waste strategic actions are necessary, particularly in Italy. The adoption in Germany of containers for the collection of small WEEE in shopping centers and residential areas generated good results; therefore they could be exported in Italy as well.

Keywords: WEEE, collection, urban mining, metal recovery

1. Introduction

In the world about 30-50 Mt/y of WEEE is disposed with an estimated annual growth rate of 3-5% (Afroz *et al.* 2013; Cucchiella *et al.* 2015). Compared to traditional waste streams, WEEE management presents several challenges, mostly due to their heterogeneity in terms of size, weight, function and material composition. If improperly managed, e-waste may generate significant human health and environmental risks because of the presence of hazardous substances, such as heavy metals, flame retardants and refrigerator substances (Tsydenova and Bengtsson, 2011; Biganzoli *et al.*, 2015). It was estimated that around 2 Mt/y of WEEE illegally leave Europe (Zoetman *et al.*, 2006). EU is heavily dependent on the importation of metals and e-waste illegal routes and improper management implicate not only a relevant

potential environmental harm but also a loss of rare resources that could be recycled.

To ensure the proper collection and recycling of e-waste, Directive 2012/19/EU was issued, defining general requirements about collection, recycling objectives and management. Ten e-waste categories were defined, however they will be reduced to five by August 2018. Directive 2012/19/EU expressed WEEE collection target as %-wt of EEE put on the market (POM) in the previous 3 years (45% in 2016-2019, 65% from 2019), and a collection target equal to 85% of WEEE generated (WG) from 2019. One of the main changes introduced, in comparison with previous Directive 2002/96/EC, concerns the re-definition of the collection target from 4 kg/cap to a percentage-based approach related to POM or alternatively WG. The advantage of the new target-setting mechanism is that it is more directly related to actual quantities, and thus it better represents differences between Member States' socio-economic conditions. Moreover, POM target does not necessarily reflect the amounts of EEE becoming waste for some categories, because of products lifespan.

The aim of this paper is the assessment of WEEE management systems in Germany and Italy, comparing two specific urban areas that are similar about size and socio-economic development level: Hamburg and Turin. The final goal of the research is to provide suggestions that could improve WEEE management in the considered backgrounds.

2. Methodology

This work analyses two specific EU contexts, Germany and Italy, with a focus on metropolitan areas having similar populations: Hamburg (1.8 M inhabitants) and Turin (2.3 M inhabitants). The approach considers the regulations and WEEE classification, the management systems and collected amounts.

a. WEEE management in Germany

Legislation: Actual national law about WEEE has been ElektroG2 since 2015. EAR (*Elektro-Altgeraete-Register*) is the German Coordination Centre for WEEE. ElektroG2 establishes collection targets according to Directive 2012/19/EU and highlights producer's responsibility about

design and production of new equipment. EEE are labeled with instructions for the use and disposal of end-of-life items, with the aim to influence consumers to properly dispose e-waste into dedicated collection points. ElektroG2 collects data from registered producers, collection points and treatment facilities. Producers, resellers and distributors have to register to the Clearing House (*Stiftung EAR*) and to communicate every year the amount of EEE put on the market and of collected WEEE. With these information EAR guarantees the presence of an adequate number of containers for each WEEE category at public collection points and coordinates the collection from producers. Public waste management authorities (PWMAs) take care of collection in case of producers related to individual take back system or operating in a collective system; anyway, the producers cover all additional costs for collection. ElektroG2 places no direct financial responsibility on the producers for EEE put on market before 8/13/2005, making WEEE owners responsible for disposal. ElektroG2 regulates the take back system at resellers, which transitioned from a voluntary basis to a compulsory action. From 7/24/2016 distributors or online resellers have to accept WEEE with or without purchase of new equipment.

Three different collection systems are present in Hamburg. They are the *drop-off* system, the *pick-up* system and the *container storage* (Schimpf, 2016). The first one implies that citizens bring their old electronic equipment, without any charge, to one of the 12 municipal collection points or to distributors and resellers shops. The *pick-up* system consists in the collection of e-waste directly at households (with a cost around 35€). Lastly, all around the city there are about 120 storage containers, called *depots*, in particular near shopping centres or in residential areas, where citizens can leave small e-waste (dimensions <50 cm). These containers are emptied approximately every two weeks by the PWMA.

WEEE are classified by German law into 5 product categories that are separately collected:

1. Large household appliances and white goods;
2. Cooling and freezing appliances;
3. IT and telecommunications technology;
4. Light equipment and discharge lamps;
5. Small household appliances and consumer equipment;

b. *WEEE management in Italy*

Legislation: Italian current regulation about WEEE is D.Lgs 14/2014, which acknowledges from EU regulation the key concepts of producer's responsibility and national WEEE coordination center (*Centro Coordinamento RAEE*). Producers label EEE with recycling symbols and can apply a fee for e-waste management on the selling price. Distributors collect without any charge end-of-life equipment even without any new purchase, and then deliver WEEE to municipal collection centers. Producers

organize, individually or through collective systems, the transport from collection centers (managed by PWMAs) to treatment facilities, the recycling and recovery of reusable fractions and the disposal of non-recoverable materials. Producers give to the municipalities' efficiency rewards if they achieve the targets amounts of collected e-waste. In Italy, there are 17 collective systems associated with *Centro Coordinamento RAEE*. The collective systems are consortia funded by EEE producers, resellers and importers. *Centro Coordinamento RAEE* assigns to each collective system an e-waste amount proportional to the market share of the corresponding financing companies. Collective systems are different about type of treated WEEE and they sign agreements with ANCI (national association of Italian municipalities) to gather the amount of WEEE assigned by *Centro Coordinamento RAEE*. Another particular aspect of Italian management system is that collective systems pay the treatment companies, PWMAs and local operators to manage R1 and R3 e-waste (considered hazardous); however treatment companies, PWMAs and local operators pay the collective systems to have R2 and R4 categories (60-80-100 €/ton, depending on e-waste type). This two-way business conduct was introduced in the past when the market price of the metals was high, and it is still operating nowadays.

Two different collection systems are present in Turin. They are the *drop-off* system and the *pick-up* system. Both are free of charge for consumers and 10 municipal collection points exist.

WEEE are classified by Italian law into 5 product categories that are separately collected:

- R1 - Cooling and freezing appliances
- R2 - Large household appliances
- R3 - TV and monitors
- R4 - Small household appliances
- R5 - Light sources.

3. RESULTS AND DISCUSSION

The average values about e-waste collection from households in Germany and Italy, and in Hamburg and Turin metropolitan areas, in 2015 (see Table 1) show appropriate values per cap if compared to EU target, however the %-based values are far for both countries and urban areas from Directive 2012/19/EU requirements. However, even if the number of collection points per km² is quite similar in the two urban areas and Italian pick-up system (particularly significant for large equipment) is free of charge, the highest efficiency of Hamburg collection system was demonstrated. In the following e-waste categories are defined as in Directive 2012/19/EU.

In Germany, cat.1- large household appliance (42.9%-wt), cat. 5- small household appliances and consumer equipment (31.0%-wt) and cat.3- IT and telecommunications equipment (17.1%-wt) were the highest fractions collected in 2015 according to *Stiftung EAR*. WEEE collection trends in 2007-2013 exhibit a 24% increase against a -2% of EEE placed on

Table 1. EU collection targets for e-waste and description of Hamburg and Turin metropolitan areas' main features and data about WEEE collection for 2015 (n.a.: not available)

Collection targets according to Directive 2012/19/EU				
before 2016	2016-2019		after 2019	
4.0 kg/cap	45%-wt ¹		65%-wt ¹ /85%-wt ²	
	Germany ³	Hamburg ³	Italy ⁴	Turin ⁴
population	81,799,600	1,787,408	60,655,625	2,282,197
population density (/km ²)	233	2369	192	334
No. of municipal collection points (/km ²)	n.a.	1/64.5	n.a.	1/58.3
total WEEE collected (t)	630,557	9125	249,253	7714
collection (kg/cap)	7.71	5.10	4.11	3.38
collection (%-wt ¹)	37.10	25.20	28.81	18.73

¹of EEE placed on the market in the previous 3 years

²of WEEE generated

³(Stiftung EAR, 2015)

⁴(Centro Coordinamento RAEE, 2015)

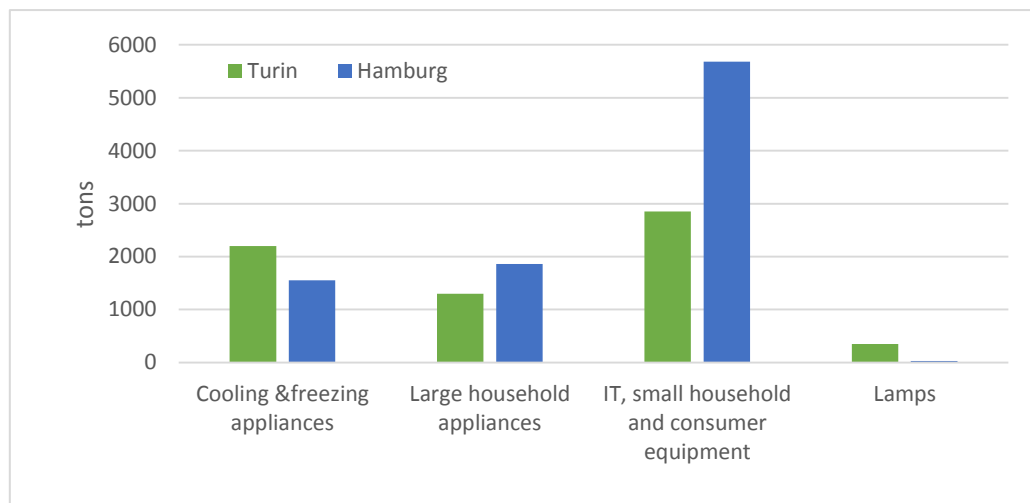


Figure 1. Comparison of collected e-waste categories in Hamburg and Turin metropolitan areas in 2015 (Stiftung-EAR and Centro Coordinamento RAEE)

the market in the same period. Hamburg data confirm national trends about collection of different e-waste categories.

In Italy, R1- cooling and freezing appliances (28.2%-wt), R2- large household appliance (27.6%-wt), R3- TV and monitors (26.1%-wt) and R4- Small household appliances (17.4%-wt) were the highest fractions collected in 2015

according to Centro Coordinamento RAEE. WEEE collection trends in 2007-2013 exhibit a 6.5% decrease against a -40% of EEE placed on the market in the same period. Turin data confirm national trends about collection of different e-waste categories.

From a general viewpoint, e-waste collection in Turin metropolitan area showed a larger increase (16.4%) if

compared to Hamburg (1.91%) in 2015 vs 2014, even if the amounts of EEE placed on the market in the two contexts were largely different (Eurostat, 2016). Turin area in fact, although heavily affected by international economic crisis, had higher margins of improvement about WEEE collection.

As before mentioned, Italian and German systems refer to different classification of e-waste. An attempt of direct comparison about the collection of different WEEE categories in 2015 (see Figure 1) considered together as “IT, small household and consumer equipment” respectively German cat.3 and 5 and Italian groups R3 and R4. Cooling and freezing appliances refer to German cat.2 and Italian R1, while large household appliances to German cat.1 and Italian R2, and lamps to German cat. 4 and Italian R5. The total amount of collected “IT, small household and consumer equipment” in Hamburg was almost twice than in Italy. We hypothesize that the reason is probably connected to the presence of the 120 containers, positioned near shopping centers or in residential areas that are specifically designed for e-waste with a size below 50 cm (according to the new WEEE classification that will be introduced in August 2018 according to Directive 19/2012/EU).

Cooling and freezing appliances and large household appliances collection showed a gap of about 42-43%, respectively in favor of Turin and Hamburg.

Lamps were collected about ten times more in Turin than in Hamburg. However, considering the expected WEEE trends in Europe, lamps category has the highest growth rate. In fact, it is expected to increase by 51% in the next decade, mostly because of fluorescent lamps (European Commission, 2014).

4. CONCLUSIONS

This relevant difference observed in the two considered urban areas about the collection of “IT, small household and consumer equipment” e-waste represents an important aspect to be considered. In fact, both in Germany and in Italy the collection of cooling appliance and large household is easier, also because of their larger size, thanks to drop-off and pick-up systems. On the other hand, it is more common to stock small e-waste in households: as an example, it was estimated that over 83M of waste mobile phones are stored in German households (Xu *et al.*, 2016).

References

- Afroz R., Masud M. M., Akhtar R. and Duasa J. B. (2013), Survey and analysis of public knowledge, awareness and willingness to pay in Kuala Lumpur, Malaysia – a case study on household WEEE management, *Journal of Cleaner Production*, **52**, 185–193.
- Biganzoli L., Falbo A., Forte F., Grosso M. and Rigamonti, L. (2015), Mass balance and life cycle assessment of the waste electrical and electronic equipment management system implemented in Lombardia Region (Italy), *The Science of the total environment*, **524-525**, 361–375.
- Cucchiella F., D’Adamo I., Lenny Koh S. C. and Rosa P. (2015), Recycling of WEEEs. An economic assessment of present and future e-waste streams, *Renewable and Sustainable Energy Reviews*, **51**, 263–272.
- Eurostat (2016), Waste statistics - electrical and electronic equipment, http://ec.europa.eu/eurostat/statistics-explained/index.php/Waste_statistics_-_electrical_and_electronic_equipment, last accessed 30.05.2017.
- Schimpf I. (2016), Bewertung des Hol- und Bringsystems für Elektro- und Elektronikaltgeräte anhand identifizierter Einflussfaktoren am Beispiel Hamburgs.
- Tsydenova O. and Bengtsson M. (2011), Chemical hazards associated with treatment of waste electrical and electronic equipment, *Waste management*, **31** (1), 45–58.
- Zoetman B. C. J. (2006), Global Waste Electrical and Electronic Equipment (WEEE) streams estimates.