



Full length article

Modelling the levels of historic waste electrical and electronic equipment in Ireland



Michael Johnson^{a,*}, Colin Fitzpatrick^a, Michelle Wagner^b, Jaco Huisman^b

^a Department of Electronic and Computer Engineering, University of Limerick, Plassey Technological Park, Castletroy, Limerick, Ireland

^b United Nations University, Vice Rectorate in Europe, Sustainable Cycles Programme (SCYCLE), Platz der Vereinten Nationen 1, 53113 Bonn, Germany

ARTICLE INFO

Keywords:

WEEE
E-waste
Recycling
Statistical analysis
Empirical validation

ABSTRACT

The implementation of the WEEE Directive in Ireland introduced a formal system for the return & environmentally sound management of WEEE. Visible fees were introduced to cover the cost of the environmentally sound management of “historic WEEE”. However, very little was known about the levels of historic WEEE that would arise, which created uncertainty with regard to funding the management of this historic WEEE.

This research employed novel modelling techniques in order to determine existing WEEE levels and predict the percentages of historic WEEE in Ireland. The research focused on “cold”, “large domestic appliances” and television WEEE and calculates Irish historic WEEE levels using data from disparate sources. The model determines EEE sales, total WEEE figures and the ratio of historic to non-historic WEEE for years 2000–2020.

The research findings indicate that historic WEEE comprises well over 50% of all material returning through official WEEE take-back channels in Ireland in 2015. Model predictions range from 2015 figures showing 69% cold WEEE will be historic in nature, 59% of large domestic WEEE will be historic and 77% of all television WEEE will be historic. For 2020, these figures will reduce to 45% historic WEEE for the cold category, 38% historic WEEE for large domestic appliances and 54% historic WEEE for televisions.

These model results were validated using a statistically significant sampling of WEEE in Ireland over the course of 1 year. Cold, domestic appliance and television WEEE were sampled in order to determine the actual ratio of historic versus non-historic WEEE.

1. Introduction

In this report, the specification, development and validation of a model for the prediction of historic WEEE return rates in the Irish market is detailed. It was developed as a collaborative work between the University of Limerick and the United Nations University (UNU), and models the Irish return stream figures for EEE, WEEE and historic WEEE for the years 2000–2020 inclusive.

The implementation of the Waste Electrical and Electronic Equipment (WEEE) Directive in Ireland in August 2005 was a landmark event in the recycling of electrical and electronic equipment (EEE) in Ireland. Prior to this, end-of-life practices for such equipment were unstructured with no overarching framework, and landfilling and dumping were widespread. Under the new regulations, a take-back infrastructure at civic amenity sites and retailers was established, landfilling was banned and recycling was made mandatory with a collection target of 4 kg per person per year. Furthermore, according to the directive, the environmentally sound management (ESM) of any

equipment placed on the market after 15 August 2005 must be financed by the producers, and for products already on the market, visible fees were agreed. These visible fees are implemented at the time of sale of certain new equipment in order to create a fund to finance the ESM of the historic WEEE arising from products already on the market. Two “not for profit” WEEE compliance schemes were established by producers to assist with the compliance with these new obligations.

These visible fees associated with EEE sales have allowed the build-up of contingency funds for the ESM of historic WEEE; however, the question of how much money will actually be required was not fully resolved when the visible fees were agreed as the necessary information to make such a judgement was simply not available. However, those involved in the collection of WEEE in Ireland have observed that historical WEEE continues to show up in significant quantities at all WEEE collection points across the country. At that time there was no way of accurately measuring or predicting the return rates of historic WEEE, hence it was still unclear how much longer before all of the historic WEEE has made its way back into the return stream for recycling. This

* Corresponding author.

E-mail addresses: michael.johnson@ul.ie (M. Johnson), colin.fitzpatrick@ul.ie (C. Fitzpatrick), wagner@unu.edu (M. Wagner), huisman@unu.edu (J. Huisman).

paper details research carried out to address this and other related uncertainties, in order to provide an evidential basis for the continued use of visible fees and predict the return rates of historic WEEE in Ireland in the future.

Section 2 of this paper contains a brief review of the WEEE Directive and related WEEE/e-waste literature from a global and regional viewpoint. The specification and development of the model created through this body of work, herein referred to as the “WEEE Generated Model”, are described in Section 3. Section 4 details the modelling results and presents the predicted levels of EEE, WEEE and historic WEEE in Ireland up to the year 2020. The validation of the model and its findings are described in Section 5. This validation was performed by comparing the model results with sampled data collected from various Irish civic amenity sites, retailers and WEEE recycling facilities. Finally, the conclusions and recommendations from the project are presented in Section 6.

2. Literature review

2.1. Introduction

WEEE (also sometimes referred to as e-waste) is one of the fastest-growing solid waste streams across the globe. Dwivedy and Mittal (2010) attribute this rapid growth to factors such as continuous technological innovations, combined with increasing consumer demand, which has led to a rapid proliferation of electronic devices on the market. With this ever-increasing market for EEE, correspondingly large quantities of WEEE are being generated. Furthermore, this phenomenon is compounded at present by decreasing product lifespans and an increasing range of new and different product types, as highlighted in a recent article from the German Environment Agency (UBA).¹ This review presents an overview of the WEEE Directive, the software tools and systems used in the development of the WEEE flows model and a review of WEEE quantification studies worldwide.

In 2014, the UNU-IAS published the first global e-Waste (or WEEE) monitor report (Baldé et al., 2015). In this document, the authors describe the emergence of e-waste, or WEEE, as one of the fastest-growing waste streams worldwide, with complex characteristics and an aggressive growth history, facilitated by the shorter times-to-market of modern technology and ever-shortening product lifespans.

The authors of the report estimated that the amount of e-waste generated globally in 2014 was approximately 41.8 million tonnes. Of this, approximately 6.5 million tonnes was reported as being formally treated by national take-back and recycling/reuse schemes. In the EU alone, 700,000 t of WEEE ends up in rubbish/waste bins annually. The amount of e-waste is expected to grow to 49.8 million tonnes by 2018, with an annual growth rate of 4% to 5%.

Most of the e-waste surveyed in the report was generated in Asia: 16 million tonnes in 2014. The highest per inhabitant e-waste quantity (15.6 kg/inhabitant) was generated in Europe, with a total e-waste generation total (including Russia) of 11.6 million tonnes. Oceania generated the lowest quantity of e-waste, 0.6 million tonnes. However, on a per-inhabitant scale, the amount was nearly as high as in Europe (15.2 kg/inhabitant).

Africa generated the lowest amount of e-waste per inhabitant: only 1.7 kg/inhabitant was generated in 2014. This equates to 1.9 million tonnes of e-waste for the whole continent. The Americas generated 11.7 million tonnes of e-waste in 2014 (North America generated 7.9 million tonnes, Central America generated 1.1 million tonnes and South America generated 2.7 million tonnes), which represented 12.2 kg/inhabitant.

In the EU, approximately 40% of the WEEE generated annually is

treated through approved recycling and reuse channels at present (see Magalini et al., 2016 for more information); in the USA and Canada, the level is around 12%; for China and Japan, it is around 24–30%; and in Australia, it is around 1%.

2.2. Ireland and the waste electrical and electronic equipment directive

To improve the end-of-life handling of WEEE (which can cause major environmental and health problems if not properly managed), lessen the impact of such waste on the environment, contribute to a circular economy and enhance resource efficiency in this sector, the WEEE Directive was introduced in the European Union (EU). The first EU WEEE Directive (2002/96/EC) was passed in 2002 as a producer responsibility directive which sought to improve the sustainable management of electronics at the end of their life by promoting the reuse, recycling and recovery of WEEE.

In Ireland, after its transposition to national law, all producers and distributors (retailers) of EEE had to comply with the 2005 National WEEE Regulations [Statutory Instrument (S.I.) No. 340 of 2005]. These regulations catered for both commercial [i.e. “business to business” (B2B)] and domestic [i.e. “business to consumer” (B2C)] producers and distributors. The original WEEE Directive set an initial collection target of 4 kg, on average, per head of population per year of WEEE from private households (to be achieved by 31 December 2006).

In December 2008, the European Commission proposed that the original WEEE Directive be revised in order to address a number of shortfalls. These shortfalls were related to, for example, the unparalleled increase in the magnitude of the waste stream, which meant that original collection targets needed to be revised; the need to address illegal shipments of WEEE outside the EU by enforcing compliance with Waste Shipment Regulations more stringently; allowing reuse organisations access to WEEE material and the revision of the method for calculating collection rates in various member countries in the future.

The revised (recast) WEEE Directive [Directive 2012/19/EU of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE)] was published on 4 July 2012 and came into effect on 13 August 2013. Member States had to transpose the revised WEEE Directive into national legislation by 14 February 2014. Key differences in the recast WEEE Directive include:

- More ambitious collection targets [a 45% take-back of what is placed on the market averaged across the previous 3 years’ placed-on-the-market (POM) figures] to apply from 2016. This target will increase to 65% of EEE placed on the market or, alternatively, 85% based on WEEE generated after 2019. The existing collection target of at least 4 kg per person remained in place until the end of 2015.
- An increase in recovery targets: mandatory collection targets have increased to 65% of the average weight of EEE placed on the market over the previous 3 years in each Member State. The recycling and recovery targets increased by 5% on the basis of weight.
- The scope has been widened to include all EEE, except specific exemptions. In addition, the categories have been reorganised into six types or “families”. After 14 August 2018, all types of WEEE will be covered (i.e. there will be an “open scope”).
- The free take-back of small household appliances (no more than 25 cm) to retail stores (with a sales area of at least 400 m²), regardless of whether the customer buys a new product or not.

Ireland’s 2014 WEEE Regulations [European Union (Waste Electrical and Electronic Equipment) Regulations 2014 (S.I. No. 149 of 2014)] replaced the 2005 and 2011 regulations and amendments, and give effect to the provisions of the EU WEEE Directive 2012/19/EC in national legislation.

¹ <http://www.endseurope.com/article/45200/uba-calls-for-product-resource-efficiency-policies>.

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