ARTICLE IN PRESS

Waste Management xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Using choice architecture to exploit a university distinct urban mine

Xavier Pierron[a,*], Ian D. Williams[b], Peter J. Shaw[b], Victoria Cleaver[b]

[a] School of Strategy and Leadership, Coventry University, Priory Street, Coventry CV1 5DL, United Kingdom
[b] International Centre for Environmental Science, Faculty of Engineering and the Environment, University of Southampton, Highfield Campus, Southampton SO17 1BJ, United Kingdom

ARTICLE INFO

Article history:
Received 22 November 2016
Revised 15 May 2017
Accepted 18 June 2017
Available online xxxx

Keywords:
Choice architecture
Distinct urban mine
University students
WEEE
Secondary materials
Monetary potential

ABSTRACT

There are widespread concerns regarding the potential future scarcity of ferrous and non-ferrous materials. However, there are already potentially rich reserves of secondary materials via high ownership of Electrical and Electronic Equipment (EEE) in economically-developed nations. Young people are particularly high consumers of EEE, thus university students and campuses may present an opportunity to harness this potential. University Distinct Urban Mines (DUM) may be used to exemplify how potential reserves of secondary metals may be exploited, and could contribute to the transition from a linear to a circular economy. This study aimed to evaluate small household appliances (SHA) DUM from a UK university, with the objectives to identify and quantify student households' SHA ownership, WEEE recycling, stockpiling and discarding habits amongst student households, assess and evaluate the monetary potential of SHA DUM at UK level, and propose methods to exploit DUM for universities in the UK.

To this purpose, a quantitative survey was undertaken to measure students' ownership and discarding behaviour with respect to SHA. The amounts of ferrous and non-ferrous materials were then estimated and converted to monetary values from secondary materials market data to appraise the SHA DUM overall value. Thirty-five per cent of SHA are discarded in the general refuse. Broken personal care appliances (PCA) tend to be discarded due to hygiene and small size factors. When in working order, SHA tend to be equally reused, recycled or stockpiled. We conclude that a total of 189 tonnes of ferrous and non-ferrous materials were available via discarding or being stockpiled at the University of Southampton. Extrapolated to UK higher education level, discarded and stockpiled SHA represent a potential worth ~USD 11 million. To initiate DUM exploitation within Higher Education campuses, we suggest improving users' choice architecture by providing collection methods specific to broken SHA.

Contents

* Corresponding author.
E-mail address: aa8129@coventry.ac.uk (X. Pierron).

http://dx.doi.org/10.1016/j.wasman.2017.06.034
0956-053X/© 2017 Published by Elsevier Ltd.

Please cite this article in press as: Pierron, X., et al. Using choice architecture to exploit a university distinct urban mine. Waste Management (2017), http://dx.doi.org/10.1016/j.wasman.2017.06.034

1. Introduction

1.1. Urban mining

Urban mining is a construct of anthropogenic resources between landfill mining and recycling to integrate secondary material flows and stocks into the Circular Economy (Cossu and Williams, 2015). A Distinct urban mine (DUM) involves the spatial and geographical delimitations of different waste categories, making cities and university campuses ideal prospection grounds due to their delimited geographical area and localised population. The concept of DUMs further advances this notion by segmenting materials such as plastic, ferrous and non-ferrous associated with specific WEEE categories (Ongondo et al., 2015). Similarly, to primary material mines, prospecting a DUM involves the aggregation of information about existing stocks and flows (Wallsten et al., 2015). Stocks can be associated with in-use and stockpiled items (EEE); material flows can likewise be associated with reusing, recycling and discarding behaviours (WEEE). The concentration of materials within a DUM depends on the products associated for specific EEE/WEEE categories as well as defined ownership levels. In fact, research by Mueller et al. (2015) has shown that anthropogenic mines of rare earth metals – effectively metal-specific DUMs - can now have both a higher concentration of such elements and a longer mine life than a current well-established geogenic mine. However, for a DUM to be viable, there must be reasonable economic prospects for exploiting them (Sun et al., 2015).

DUMs are considered a valid concept to evaluate potential for secondary resources recovery within the anthroposphere and cost-efficient methods need to be implemented to access them (e.g. Ongondo et al., 2015). DUMs are not only defined by their delimited space within the anthroposphere but also by the potential availability of resources for a given type of EEE. Ongondo and Williams (2011a,b) estimated that, for a specific university DUM with approximately 24,000 students in the UK rich in IT and telecommunication equipment, 20 tonnes were currently stockpiled and 87 tonnes would be available within 36 months. Without specifically identifying DUMs, previous authors have estimated the potential of stockpiled WEEE. (Milovantseva and Saphores, 2013) estimated that 84.1 million televisions were stockpiled in US attics. Ongondo and Williams (2011a,b) evaluated that close to 60 million mobile phones were stockpiled in US and European Higher Education Institutions.

If a mine is to be exploitable, urban or otherwise, it needs to be economically viable and located within reach of an existing logistics network with materials concentration at an optimal level (Zhang and Kleit, 2016). This economic feasibility is defined by the potential revenues after collecting, transporting, separating, processing and recycling materials from WEEE, accounting for the market values of recoverable secondary materials (Sun et al., 2016). These costs are largely driven by the incentives associated with the availability and accessibility of these EEE and WEEE stocks (Krook et al., 2011).

WEEE collection events are regularly organised to transform stocks into flows at community levels (WRAP, 2016). Collection events involve householders taking their WEEE to a single location at a specific time. These events are mainly aimed at smaller WEEE, as larger WEEE items are often taken away when a new product is delivered (Directive, 2002/96/EC; Directive, 2011/65/EU). Smaller WEEE tend to be stockpiled, especially if not broken when they are unwanted (Guillard and Pinson, 2012; Ongondo and Williams, 2011a). Personal care appliances (PCA) tend to be more readily discarded than other small WEEE (Darby and Obara, 2005) due in part to a lack of awareness of disposal methods (Timlett and Williams, 2008) and lack of monetary incentives (Ongondo and Williams, 2011b). Given the low residual value individual items may have, monetary incentives, if implemented, would likely be too low to trigger an intended recycling behaviour (Ariely et al., 2009; Jones et al., 2010).

1.2. Choice architecture

Several millions of mobile and smartphones are stockpiled in the UK (Ongondo and Williams, 2011b). The European Commission estimated that in 2012, approximately the equivalent of 42% of all EEE placed on the market was collected for recycling purposes (Eurostat, 2016). According to behavioural economics theory (Thaler et al., 2014) this situation could be due to a lack of valid alternatives. This would suggest a need to modify users' choice architecture as "decision-makers don't make choices in a vacuum" (Thaler et al., 2014:428); a choice architect is an organiser who designs a preferred set of alternatives to achieve a desired outcome (*op. cit.*).

In their approach to choice architecture, Thaler et al. (2014) identify three core principles: defaults or the path to least resistance, feedback and errors. Choice architecture, sometimes referred to as "libertarian paternalism", is the mapping of preferred outcomes and design of alternatives in accordance to these outcomes. Table 1 illustrates choice architecture principles applied to waste management. An example adapted to environmental behaviour is related to utility companies evaluating customers' consumption compared with the local neighbourhood or national consumption average. Choice architects have at their disposal several principles or methods they can freely adapt to any situation to influence a decision towards a desired outcome.

By transposing the concept of choice architecture into the field of waste management, alternative methods for the collection of small household appliances (SHA) could be proposed. As stated by Darby and Obara (2005), one-size-fits-all solutions are ill-adapted for comprehensive recycling efforts, and there remain challenges to the effective collection of SHA. WEEE tends to be stockpiled, regardless of its broken or unbroken status (e.g. Guillard and Pinson, 2012; Ongondo and Williams, 2011b). A distinction is sometimes made between broken, irreparable and reparable WEEE (e.g. Darby and Obara, 2005), but estimates of WEEE stockpiles do not always make this important distinction (Milovantseva and Saphores, 2013b). If WEEE stockpiling is influenced by multiple factors, then there should be different methods to convince consumers to destockpile. From a decision-mapping perspective, the decision to stockpile WEEE instead of taking it to a Take-Back Scheme (TBS) or Household Waste Recycling Centre (HWRC) would indicate that the most convenient option is preferred and users are currently unsatisfied with the current alternatives offered.

Please cite this article in press as: Pierron, X., et al. Using choice architecture to exploit a university distinct urban mine. Waste Management (2017), http://dx.doi.org/10.1016/j.wasman.2017.06.034