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Key drivers of the e-waste recycling system: Assessing and modelling e-waste processing in the informal sector in Delhi

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Abstract

The management and recycling of waste electrical and electronic equipment WEEE was assessed in the city of Delhi, India. In order to do this, the personal computer was defined as the

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tracer for which a model was designed. The model depicts the entire life cycle of the tracer, from production through sale and consumption—including reuse and refurbishment—to the material recovery in the mainly informal recycling industry. The field work included interviews with the relevant stakeholders, transect walks and literature study, which was followed by a software-supported material flow analysis (MFA) of the whole life cycle chain of the tracer item. In addition to the MFA, several economic aspects of the recycling system were investigated. The study revealed that the life span of a personal computer has considerable influence upon the system, most notably in the following two aspects: (i) a prolonged life span creates value by means of refurbishing and upgrading activities, and (ii) it slows down the flow rate of the whole system. This is one of the simplest ways of preventing an uncontrolled increase in environmentally hazardous emissions by the recycling sector. The material recovery of the system is mainly driven by the precious metal content of personal computers. A first estimate showed that precious metal recovery contributes to over 80% of the personal computer materials' market value, despite the small quantity of them found in computers.

Keywords: Material flow analysis; Informal sector; E-waste recycling; WEEE; Developing countries; Countries in economic transition; Personal computer; Upgrading and refurbishing

1. Introduction

1.1. Situation and problem description

Electronic waste, e-waste or waste electronic and electrical equipment (WEEE) can be considered a danger to human and the environment. The directive from the European Union on the restriction of the use of certain hazardous substances in electrical and electronic equipment intends to contribute to the protection of human health and the environmentally sound recovery and disposal of waste electrical and electronic equipment by means of these restrictions. "Member States shall ensure that, from 1 July 2006, new electrical and electronic equipment put on the market does not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE)." (EC, 2002a).

E-waste is a generic term embracing various types of electronic equipment. According to the definitions in the directive of the Parliament and European Union Council on waste electrical and electronic equipment, WEEE can be subdivided into the ten different categories listed in Table 1. The categories "IT and telecommunications equipment" and "consumer equipment" constitute e-waste (EC, 2002b).

In the former 15 European Union member countries (EU15) the amount of WEEE produced varied between 3.3–3.6 kg per capita for the period 1990–1999 and has been projected as 3.9–4.3 kg per capita for the period 2000–2010 (EEA, 2003). According to this study (which assessed only five appliances: refrigerators, personal computers, televisions, photocopiers and small household appliances), this amount covers only 25% of the whole WEEE stream of the EU15. Hence, these numbers correspond to other estimates of total WEEE amounts, which range between 14 (Keynote, 2003) and 20 kg per capita (estimated by AEA, cited in Enviros, 2002). The amount of WEEE generated