SOCIAL LIFE CYCLE ASSESSMENT FOR WEEE REUSE

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Abstract

The reuse of Waste Electrical and Electronic Equipment (WEEE) currently draws, worldwide, much attention from an economic, environmental, and social viewpoint. The REWEEE project aims to reduce WEEE through the implementation of prevention (reuse) and preparation for reuse actions and the development and demonstration of efficient sorting and preparation for reuse processes for a variety of WEEE, leading to an increased acceptance of used WEEE by the consumer. One of the key goals of the REWEEE project is to monitor and highlight the link among the environmental, economic and social benefits associated with WEEE reuse and preparation for reuse.

The aim of this manuscript is the presentation of the key parameters that need to be taken into account in order to assess the social impact of WEEE reuse via means of S-LCA. A social life cycle assessment (S-LCA) is a method that can be used to assess the social and sociological aspects of products, their actual and potential positive as well as negative impacts along the life cycle. S-LCA aims to assess the social and socio-economic aspects of products and processes and their potential positive and negative impacts along their life cycle. S-LCA assesses social and socio-economic impacts found along the life cycle (supply chain, including the use phase and disposal) with generic and site specific data. S-LCA encounters both positive and negative impacts of the WEEE reuse. S-LCA provides information on social and socioeconomic aspects for decision making, instigating dialogue on the social and socio-economic aspects of WEEE reuse, in the prospect to improve performance of organizations and ultimately the well-being of stakeholders.

Keywords: WEEE, reuse, sorting centres, social life cycle assessment

INTRODUCTION

Waste Electrical and Electronic Equipment (WEEE) or e-waste is one of the fastest growing waste streams worldwide. According to Directive 2002/96/EC, WEEE means "*electrical or electronic equipment which is waste within the meaning of Article 1(a) of Directive 75/442/EEC, including all components, subassemblies and consumables which are part of the product at the time of discarding*". More than 40 million tonnes of e-waste are created globally each year. The management and disposal of these kind of waste is complex and sometimes related to illegal e-waste trade towards developing countries [1]. In several countries dumping of WEEE in landfills without proper treatment, unsafe/semi-illegal handling from scavengers or illegal exports of WEEE from industrialised countries to developing ones constitutes an everyday practice.

Moreover, the revised Waste Framework Directive (2008/98/EC) which came into force in December 2009 seeks to promote the alternatives to landfill by (amongst other things) strengthening the role of the waste hierarchy as a priority order in waste prevention and management legislation and policy. The amended EU Waste Framework Directive introduced definitions for 'reuse' and 'preparing for reuse'. 'Reuse' means any operation by which products or components *that are not waste* are used again for the *same* purpose for which they are conceived. 'Preparing for reuse' means checking, cleaning or repairing recovery operations, by which products or components of products *that have become waste* are prepared so that they can be reused without any other pre-processing.

The quantities of WEEE collected and reported reused and prepared for reuse in 2012 in the EU correspond to 2% of the total WEEE collected. The UK, Germany and France lead the way [1]. WEEE reported reused and prepared for reuse in Greece is reported to be 0% for 2012 [1]. In order to enhance the public perception towards the reuse of electric appliances and the prevention of WEEE generation, an initiative has been undertaken by a group of partners [2], which is implemented via the LIFE+ ReWeee project. The project aims to prevent the generation of WEEE. In order to achieve this objective, two WEEE sorting centers will operate for the first time in Greece, in the wider region of Attika and Central Macedonia respectively. The core activity of those centers is the collection, the storage and the sorting of WEEE depending on their condition and then their preparation for reuse or treatment (see Figure 1).

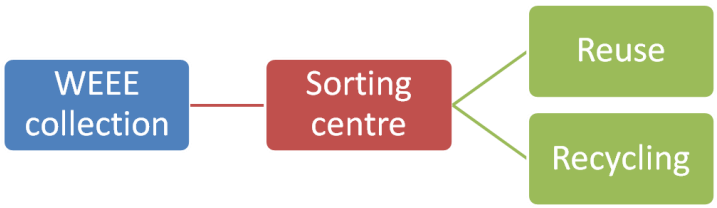

Figure 1. Focus of the LIFE+ ReWeee project.

The environmental problem that the ReWeee Project addresses, is the environmental burden caused by WEEE throughout its life cycle. This problem is further aggravated due to the continued growth of the market and the shortening of the life cycle of electrical and electronic equipment (EEE), resulting in the accelerated replacement of equipment, making WEEE a fast growing waste stream in the European market. It is estimated that about 65% of the EEE currently on the European market is separated from other household waste, but over one half of such quantity probably undergoes improper treatment and

is exported illegally. The result of this practice is the loss of valuable resources and the degradation of the environment [2].

The aim of this manuscript is the presentation of the key parameters that need to be taken into account in order to assess the social impact resulting from the operation of the two sorting centers for WEEE reuse in Greece via means of S-LCA.

WHAT IS SOCIAL LCA?

A social life cycle assessment (S-LCA) is a method that can be used to assess the social and sociological aspects of products, their actual and potential positive as well as negative impacts along their life cycle. Or in other words, social life cycle assessment addresses the impacts that a product has on people who interact with the life cycle of the product [3]. S-LCA aims to assess the social and socio-economic aspects of products and processes and their potential positive and negative impacts along their life cycle. S-LCA assesses social and socio-economic impacts found along the life cycle (supply chain, including the use phase and disposal) with generic and site specific data. S-LCA encounters both positive and negative impacts of the WEEE reuse. S-LCA provides information on social and socioeconomic aspects for decision making, instigating dialogue on the social and socio-economic aspects of WEEE reuse, in the prospect to improve performance of organizations and ultimately the well-being of stakeholders. S-LCA complements environmental LCA with social and socio-economic aspects. It can either be applied on its own or in combination with environmental LCA [4].

SOCIAL IMPACTS ACROSS THE SUPPLY CHAIN

One of the most demanding tasks in performing a S-LCA is the inventory of data, due to poor availability and accessibility of data on social and socio-economic issues in a relevant form. Social impacts are consequences of positive or negative pressures on social endpoints (i.e. well-being of stakeholders) [4]. In the methodology described in the Guidelines, the social impacts are assessed in relation to stakeholders and/or impact categories [4]. Each stage of a product's life cycle can be associated with geographic locations, where one or more of these processes are carried out (mines, factories, roads, rails, harbors, shops, offices, recycling firms, disposal sites). At each of these geographic locations, social and socio-economic impacts may be observed in five main stakeholders categories [4]:

- Workers/employees
- Local community
- Society (national and global)
- Consumers (at every stage of the supply chain)
- Value chain actors

Subcategories are the basis of a S-LCA assessment because they are the items on which justification of inclusion or exclusion needs to be provided. The subcategories are socially significant themes or attributes [4]. Subcategories per stakeholder are presented in Table 1.

Methodology sheets for each one of the impact subcategories for public consultation have been released [5]. The purpose of these sheets is to help in the implementation of the S-LCA with the suggestion of inventory indicators for each stakeholder and subcategory [5]. However, subcategories measurement and the definition of impact categories are still a challenge.

Table 1. Stakeholder categories and subcategories [4].

Stakeholder categories	Subcategories
Worker	Freedom of Association and Collective Bargaining Child Labour Fair Salary Working Hours Forced Labour Equal opportunities/Discrimination Health and Safety Social Benefits/Social Security
Consumer	Health & Safety Feedback Mechanism Consumer Privacy Transparency End of life responsibility
Local community	Access to material resources Access to immaterial resources Delocalization and Migration Cultural Heritage Safe & healthy living conditions Respect of indigenous rights Community engagement Local employment Secure living conditions
Society	Public commitments to sustainability issues Contribution to economic development Prevention & mitigation of armed conflicts Technology development Corruption
Value chain actors (not including consumers)	Fair competition Promoting social responsibility Supplier relationships Respect of intellectual property rights

THE SOCIAL IMPACTS OF WEEE REUSE

As the full supply chain of an electrical or electronic product is very complex, it will be simplified into the following life cycle stages [6]:

- Resource extraction
- Refining and processing of raw materials
- Manufacturing and assembly (including manufacturing of components, assembly of complex components and final assembly)
- Marketing and sales
- Use (i.e. customer relations)
- Recycling and disposal

The aforementioned life cycle of EEE extents across different parts of the world (see Figure 2). Raw materials are extracted from different quarries, manufacturing and assembly takes parts in Asia while the use phase takes place in Europe. The recycling of WEEE takes place within the geographical context of the use phase while the final disposal takes place, mostly, in different parts of the developing world. Note also that among the life cycle stages of EEE depicted in Figure 2, transportation of materials and equipment plays also a pivotal role. Therefore, social impacts are generated throughout the supply chain of an EEE. The following lines outline the social impacts resulting from the operation of a WEEE collection and sorting centre in the entire supply chain of an electrical or electronic appliance:

- Collection of WEEE requires personnel. Therefore it has a positive social impact since it generates new jobs
- Sorting of WEEE for preparation for reuse requires the employment of personnel which has a positive impact at the local level for the creation of jobs.
- Repair of recovered appliances generates jobs at the local level, which is a positive social impact.
- Reuse of EEE extends the life span of appliances. Therefore the demand for new appliances is reduced in the geographical context where appliances are manufactured or assembled.
- Lower demand of appliances affects also negatively all the other stages in the supply chain of electrical and electronic equipment (transportation, use, collection).

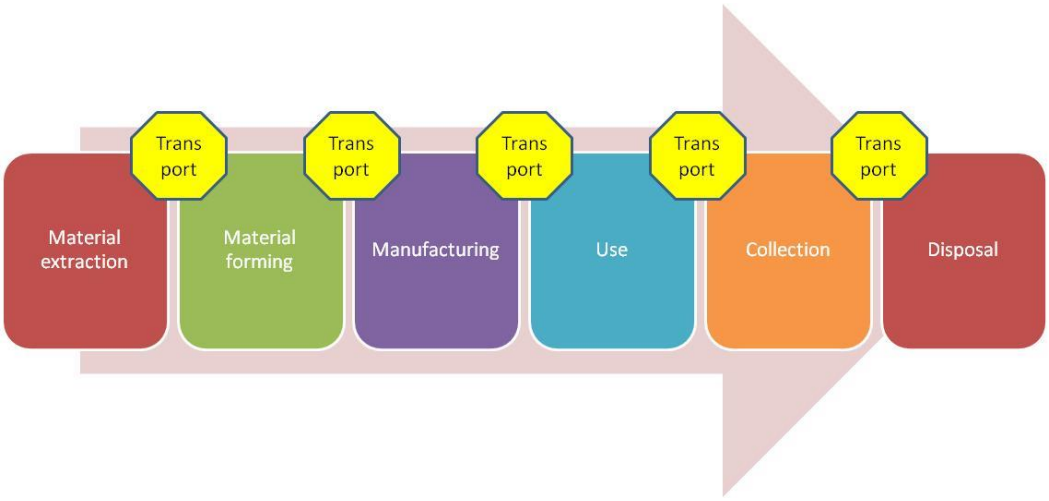

Figure 2. The life cycle of an EEE product.

Goal and scope definition

The study does not include the social impact from electricity generation and other inputs of a supporting kind, nor did it include the social impacts related to transport. These activities also have social impacts, but are not covered within the framework of this study.

Functional unit

The functional unit in the study is the operation of a sorting and preparation for reuse EEE centre operating in Greece. The case study sought to include the product system from 'cradle to grave' and the impacts on all relevant stakeholders as suggested by the UNEP Guidelines [4].

Social life cycle impact assessment

Social life cycle impact assessment is the process by which inventory data is aggregated within subcategories and categories to help understand the magnitude and the significance of the data collected in the Inventory phase using accepted level of minimum performance. No particular impact assessment method is proposed in the UNEP Guidelines [4].

CONCLUSIONS

WEEE is one of the fastest growing waste streams worldwide. Reuse of electrical and electronic equipment is among the top priorities in the EU waste hierarchy. In order to enhance the public perception towards the reuse of electric appliances and the prevention of WEEE generation, an initiative has been undertaken by a group of partners, which is implemented via the LIFE+ ReWeee project. In the framework of this initiative, two WEEE sorting centers will operate for the first time in Greece. In order to assess the social impact of the operation of the two sorting centers in Greece, social LCA. An outline for the application of social LCA in the field of WEEE reuse has been presented.

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