

Environmental life cycle assessment of water supply in South Africa: The Rosslyn industrial area as a case study

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Abstract

Environmental life cycle assessment (LCA) is an environmental management tool, which is increasingly used for decision-support in the South African manufacturing industry, e.g. for cleaner production purposes. The life cycle impact assessment (LCIA) phase of LCAs evaluates the potential environmental impact profiles of industrial activities throughout the life cycles of products and processes. The LCIA procedure is dependent on a comprehensive life cycle inventory (LCI) of the evaluated life cycle system. Water usage is included in LCIs, and is incorporated in LCIA procedures as direct extraction from available resources. However, the environmental burdens associated with water supply extend beyond extraction and include non-renewable energy use, materials use, land use, and pollution of air, soil and water resources. A LCA study was subsequently undertaken to identify key environmental aspects that should be considered where water is used in the manufacturing sector of South Africa, and to identify possible shortcomings in the LCA tool. It is concluded that the extraction of the required water from nature to supply potable water is in fact the most important consideration, and water-losses in the supply system must receive attention, especially in the municipal-controlled part. Water quality impacts are also important, although through supporting processes, and specifically electricity generation. The boosting requirements attribute most to the electricity dependency of the studied life cycle system. However, a number of data gaps were identified and recommendations are made to improve such future LCA studies in South Africa.

Keywords: life cycle assessment, life cycle management, life cycle impact assessment, water supply, water use, South Africa

Introduction

The ISO 14000 family of standards aims to achieve standardisation in the field of environmental management (ISO, 2003) and is a response to an increasing need to incorporate environmental management systems (EMS) into existing business practices (Tibor and Feldman, 1996). Life cycle assessment (LCA) is included in the ISO 14000 series (ISO 14040) as a tool for environmental management decision support (ISO, 2003).

LCA is a quantitative procedure to assess the environmental burdens associated with the life cycle of an activity (product, process, or service) (HISD, 1996). A complete life cycle (of a product) includes raw material extraction (including water), processing, transportation, manufacturing, distribution, use, reuse, maintenance, recycling, and final waste disposal (Consoli et al., 1993). The main objectives of decision makers to initiate a LCA study are to (Allen et al., 1997):

- Provide a profile (as complete as possible) of the interactions of an activity (product, process or service) with the environment
- Contribute to the understanding of the overall and independent nature of the environmental consequences of human activities
- Provide decision makers with information, which quantifies the potential environmental impacts of activities and identifies opportunities for environmental improvements.

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Identified research problem and rationale

International LCA literature indicates that few data are available pertaining to potable water production and supply, in particular with respect to the environmental burdens generated within the system. Furthermore, compared to most developed countries where the LCA procedure has been applied on water systems, i.e. Europe (Raluy et al., 2005), the total environmental burdens associated with potable water supply are ill understood in the South African context due to dissimilar infrastructure that are associated with the limited water supply. In addition to the environmental impacts that are directly related to the infrastructure, e.g. water losses, the data of the auxiliary processes to the infrastructure are also deficient in South Africa, e.g. process-specific data of electricity generation and supply, waste management, etc. Consequently, the inaccessibility to sufficient life cycle inventory (LCI) databases for South African LCA practitioners and researchers has been noted (Brent et al., 2002). Particularly, the LCIs of the three operational parameters that are usually measured in the South African manufacturing industry for cleaner production purposes (Brent and Visser, 2005), must be developed further: water usage, energy usage, and waste produced per manufactured or supplied item.

Objectives of this research

In general the project summarised in this paper (Brent and Landu, 2005) aimed to study the environmental life cycles of potable water supply systems for industrial usage in South Africa. Thereby, the following could be achieved: