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K. Angelakoglou, G. Gaidajis



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# A review of methods contributing to the assessment of the environmental sustainability of industrial systems

K. Angelakoglou<sup>1\*</sup> and G. Gaidajis<sup>1</sup>

<sup>1</sup>*Department of Production Engineering and Management, Laboratory of Environmental Management and Industrial Ecology, Democritus University of Thrace, Xanthi, Greece, 67100*

(\*Corresponding author: e-mail: kangalak@pme.duth.gr, tel: +30 25410 79356, postal address: Democritus University of Thrace, School of Engineering, University Campus, Building 1, Vas. Sofias 12 Str., 67100, Xanthi, Greece)

## Abstract

Sustainable development calls for holistic environmental performance evaluations, forcing industry to expand its responsibility towards the environment both locally and globally. The aim of this study is to review available methods that can potentially be applied by industries to support the assessment of their environmental sustainability. The paper offers a comprehensive overview of existing methods, discusses their adequacy, identifies critical future directions and provides further guidance to industrialists and researchers who wish to assess and improve the environmental sustainability of an industrial system. Forty eight (48) methods were identified which were further classified into six categories to facilitate their analysis: individual/set of indicators, composite indices, socially responsible investment indices, material and energy flow analysis, life cycle analysis and environmental accounting. Key attributes of every method were extracted whereas five criteria were set to evaluate the selected categories: ability to promote actions of improvement, help decision making, potentiality for benchmarking, applicability and ease of use and integration of wider spatial and temporal characteristics. Results have indicated that there is still noteworthy potential in increasing the efficiency of environmental sustainability assessments of industrial systems. The scope of the evaluation varies considerably among different methods. Over 140 different environmental issues are addressed by the examined methods to assess environmental aspects of sustainability. Energy use, human toxicity, ozone depletion and resource consumption are the most utilized parameters. Composite indices and life cycle analysis based methods, exhibit the highest potential for satisfying all five criteria set. The key conclusion emerged from this study is that there is considerable margin of improvement especially regarding methods' ability to help decision making and ease of use. The most critical future direction in order to enhance the effectiveness of the assessment is the development of commonly accepted sustainability reference targets. The establishment of reference targets will enable the quantification of the distance between the existing situation and the truly environmentally sustainable performance.

**Keywords:** review; environmental assessment; industry; sustainable development; environmental sustainability

## 1. Introduction

Since the achievement of sustainability has been set as a primary goal of modern society, the assessment of whether we move towards sustainability (and how far we are from it) is crucial. A simple definition of sustainability assessment is “a process that guides decision making towards sustainability” (Hacking and Guthrie, 2008). Devuyst et al. (2001), have defined sustainability assessment as “a tool that helps decision and policy makers to decide what actions should follow or not, in an attempt to make society more sustainable”. What can be concluded from the above mentioned definitions is that sustainability assessment is being evolved mostly as a decision making tool (Pope et al., 2004). How someone perceives and defines sustainability, as well as the time boundaries set for monitoring its achievement, significantly affect the assessment (Ness et al., 2007) and the expectations of the results (Bond and Morrison-Sanders, 2011).

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