
Letter to the Editor

Owens, J. W. 1997. **Discussion on Constraints of Life Cycle Impact Assessment.** Letter to the editor responding to H.A. Udo de Haes's letter regarding J.W. Owens's (Winter 1997) "Life-Cycle Assessment: Constraints on Moving from Inventory to Impact Assessment," *Journal of Industrial Ecology* 1(1): 37–49.

The underlying questions in 'Life-Cycle Assessment: Constraints on Moving from Inventory to Impact Assessment' came from the perspective of an environmental manager: What is the nature of the information that life cycle assessment (LCA) and, specifically, its life cycle impact assessment phase (LCIA) offer? What is the value of the information, i.e., the strengths and shortcomings of the system and its information? How can the strengths be utilized and the shortcomings compensated for or overcome?

As to the question of the nature of information LCA and LCIA offer, there are two answers. First, LCA is a relative approach that makes it distinct from many other environmental techniques (SETAC, 1997; ISO, 1997). Second, there is a now growing acknowledgment that the LCIA results are indeed pressure or loading indicators. Both SETAC (1997) and ISO (1997) describe LCIA as using numerical indicators for selected impact categories. These indicators condense and simplify inventory results to reflect an estimate or approximation of aggregated emission loadings and resources used. Both SETAC (1997) and ISO (1997) have also recognized that LCIA indicators vary widely in their reliability and representativeness due variations in spatial and temporal scale between LCIA and a number of environmental processes. They have also recognized differences between simplifying assumptions in LCIA and the diverse set of environmental processes that LCIA attempts to describe.

As to the question of strengths and shortcomings, the greatest need for discussion and clarification centers on the issue of subjectivity in LCIA. This is separate from basic default assumptions that must be disclosed and the existence of varying levels of uncertainty that need to be dimensioned. These tasks are true for any technique. LCIA is currently unique in the extensive and pervasive use of subjective judgments. Subjective judgments are used in many categories, and they influence or determine LCIA results in ways that are not transparent to most LCA users and audiences. Current proposed methods use and even rely on subjective judgment to create categories and to justify aggregation into indicators. The clearest examples are ecotoxicity, toxicity, and resources. In each case, different toxicities, e.g., cancer, liver toxicity, and eye irritation, or different resources, e.g., iron, aluminum, and wood, are combined into a final indicator or score. This is equivalent to the valuation of global warming, acidification, and so on. Thus, such indicators do not have a scientific underpinning or justification and, in fact, their aggregation is inconsistent with or even contradictory to science that regards the effects or resources as independent and non-additive. This has led to another exchange of letters about LCIA subjectivity in another journal (Heijungs and Guinée, 1996; Hertwich, 1996).

As to how to utilize the strengths of LCA, the answer is that its broad, relative approach enables an organization and framing of possible issues for a system. However, this is not an

automatic process. Users must recognize the need to deliberately design LCA studies based on targeted issues so that the inventory and impact assessment are coordinated (SETAC, 1997). Users must also recognize that they must be alert during the iterative stages of a study for the emergence of undetected issues.

This arrives at a basic conclusion: the LCA indicators are in many cases largely directional and qualitative and in other cases are pseudo-valuations and scores. Life cycle impact assessment results are not similar to the more widely understood quantitative mass and energy numbers of the inventory phase. The subjective judgments and scores indeed combine with a high level of uncertainty for most environmental issues. This level of uncertainty is typically greater than in other environmental techniques, except when those techniques are operating in a very basic screening mode. This leads to the conclusions: for most system comparisons, LCIA is not by itself sufficient. LCA and LCIA are not the 'core of the information' but when properly done can be the 'organizing frame of the puzzle.' The core answers will come from other techniques and information sources applied to the issues that LCA and LCIA raise.

When properly used, other techniques and information sources can then compensate and overcome the environmental shortcomings of LCA, e.g., subjective judgments, scoring, and high levels of uncertainty. This combination is not intended to be a literal direct integration of separate techniques, but for the environmental manager to consciously plan and gather appropriate information from the separate techniques to make sound decisions. Information from LCA's broad, but rudimentary, screening capabilities can be used with information from other environmental techniques in an overall environmental management framework. The goal is to have each technique performing the task and providing the manager with information to which it is best suited, while other complementary techniques address the weaknesses and limitations of others. We again offer our preliminary scheme for environmental management where different techniques are used (DeSmet et al., 1996) and note the publication of our case study (Owens, 1996) and others (Hogan et al., 1996) exploring this subject of information integration in relation to LCIA.

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