Abstract

Goal, Scope and Background. Societal assessment is advocated as one of the three pillars in the evaluation of, and movement toward, sustainability. As is the case with the well established LCA, and the emerging LCC, societal life cycle assessment should be developed in such a way as to permit relative product comparisons, rather than absolute analyses. The development of societal life cycle assessment is in its infancy, and important concepts require clarification including the handling of the more than two hundred social indicators. Therefore, any societal life cycle assessment methodology must explain why it is midpoint- or endpoint-based as well as its reasons to be complimentary with, or included within, life cycle assessment.

Methods. A geographically specific midpoint based societal life cycle assessment methodology, which employs labour hours as an intermediate variable in the calculation has been developed and evaluated against an existing LCA comparing two detergents. The methodology is based on using an existing life cycle inventory and, therefore, has identical system boundaries and functional units to LCA. The societal life cycle assessment methodology, much like LCA, passes from inventory, through characterisation factors, to provide an ultimate result. In analogy to economics and cost estimation, societal life cycle assessment combines, into its statistics, both data as well as estimates, some of which are correlated to elements of the LCI. It focuses on the work hours required to meet basic needs.

Results. The societal life cycle assessment of an appended case study indicates that Detergent 2 generates, relative Detergent 1, approximately 20% less employment in Russia, 35% less in France, and approximately five times more in Canada and South Africa, the latter derived from its higher aluminium content. There is essentially no difference in the employment in the use country (Switzerland) nor in Morocco, where some of the waste disposal was assumed to take place.

Discussion. Given that housing is more affordable, in terms of shelter per labour hour, in South Africa, compared to Europe, it is, therefore, of no surprise that Detergent 2 provides a societal benefit in terms of housing. Detergent 2 does, however, result in dematerialization, in that its environmental impact is lower (LCI). Therefore, as less resources are employed and labour required, in extraction, production and transport, the societal benefits in health care, education and necessities, a grouped variable, are lower for Detergent 2. This is despite the employment shift away from Europe and to less ‘developed’ regions.

Conclusions. The assessment of societal impacts involves several hundred specific indicators. Therefore, aggregation is, if not impossible, at least heavily value laden and, therefore, not recommended. The impact of a societal action, derived from a product purchase or otherwise, is also highly local. Given this, societal life cycle assessment, carried through to the midpoints, and based on an existing LCI, has been developed as a methodology. The results, for an existing LCA-detergent case, illustrate that societal life cycle assessment provides a means to investigate how policy and policy makers can be linked to sustainable development. The sensitivity analyses also clarify the decisions in regards to product improvement.

Recommendations and Perspectives. The goal of societal life cycle assessment is not to make decisions, but rather to point out tradeoffs to decision- or policy-makers. This case, and the methodology that it is based on, permit such a comparison. Substituting Detergent 2 for Detergent 1 reduces resource use at the expense of an increase in atmospheric and terrestrial emissions. Access to housing is improved, though at the expense of education, health care and necessities. As a recommendation, one would look at the fact that the majority of indicators are superior for Detergent 2 relative to Detergent 1 and seek to improve the aqueous emissions in Detergent 2 via a change in the formulation. An energy or fossil fuel substitution at the site of production could also improve the societal benefits in terms of education and health care.

While societal life cycle assessment remains in its infancy, a methodology does exist. The field can, therefore, be viewed in a similar way to LCA in the early 1990s, with a need to validate, consolidate and, ultimately, built toward a standard. The contribution is aimed at contributing to such a discussion and therefore proposes that a societal life cycle assessment be LCI-derived, geographically specific, based on mid-points, and use employment as an intermediate variable.

Keywords: Decision-making; detergents; life cycle costing (LCC); life cycle inventory (LCI); policy-making; social impacts; social indicators; societal assessment; sustainability

Introduction

Societal assessment is viewed by some authors (Klöpffer 2006) and organisations as a complement to Life Cycle Assessment and Environmental Life Cycle Costing (Hunkeler et al. 2006) as a third component of measuring sustainability development. That is not to say that there is a consensus as to how to integrate, let alone calculate, comparative social effects of products (Hunkeler and Rebitzer 2005). The field of sustainability assessment is, indeed, new, and includes contributions related to including social aspects within LCA (Weidema 2005, Weidema 2006). Clearly, as the methodology of societal assessment evolves approaches must be distinguished wherein societal assessment is combined-within or combined-with other methods. The earliest example of the former is the work by O’Brien and Clift in 1996. An additional means for categorisation relates to the issue of midpoint versus end-point calculations. As the number of...
Methodology and Case Study

Societal Life Cycle Assessment

social indicators is large, at over two hundred, the issues of thresholds and screening must be addressed for any mid-
point based procedure. Very recent work on societal assess-
ment, as well as social indicators, includes the contributions of 
Drayer et al., Labuschagne and Brent, Weidema, Norris 
and Klöpffer, all published in 2006.

The present paper is a preliminary attempt to elaborate a 
methodology for mid-point based societal life cycle assess-
ment for comparative product assertions. From the outset, 
the goal is to render this procedure compatible with LCA and 
Environmental-LCC, and, is therefore, based on the same func-
tional unit and system boundaries as these methods (Rebitzer 
and Hunkeler 2003). This is demonstrated using a case study 
evaluating two detergents for which the life-cycle inventory 
has been previously published, and extensively cited.

The specific goals of this publication are to demonstrate that 
societal life cycle assessment can be:

- based on a precise methodology
- linked to inventory data
- calculated via characterisation factors similar to those in 
  LCA
- linked to databases which estimate the geographical dis-
  tribution of a product’s burden

Societal life cycle assessment will, it seems, differ from LCA 
in one important regard. In LCA impacts are geographically 
homogenised, with continental or global averages often as-
sumed. We will attempt to illustrate, herein, that societal 
life cycle assessment is linked, at the minimum in part, to 
how a product’s life cycle affects regional employment. As 
key societal indicators, such as housing, health care, educa-
tion and necessities are very regionally dependent, societal 
life cycle assessment will require an additional set of prod-
uct specifications throughout the life cycle. Specifically, and 
as will be shown, comparative mid-point based societal life 
cycle assessment must specify the geographical distribu-
tion of labour in the extraction, transport, use and disposal stages.

This publication is intended as a preliminary model for so-
cial life cycle assessment. It is written as a specific docu-
ment to provide a base for criticism as well as a means to 
provoke the advancement of the procedure. In doing so, we 
attempt to set societal life cycle assessment at a point roughly 
equivalent to LCA in the early 1990s. A case study presented 
in the appendix will, to the extent possible, use published 
data, with some estimates provided. As will be demonstrated, 
societal life cycle assessment will require the establishment of 
some unique, though not difficult to obtain, regionally-
specific databases.

1 Methodology

A procedure for societal life cycle assessment is proposed 
derived from life cycle inventory data. As such, the analyses 
have identical system boundaries and functional units. The 
methodology will be explained, both qualitatively and math-
ematically, step-by-step from the Societal LCI, through the 
characterisation factors, which them selves depend on the 
geographical distribution of employment. Overall, the Soci-
etal LCA proposed herein comprises five principal steps 
which quite resemble environmental LCA:

1. A geographically specific life cycle inventory is estab-
lished for each unit process.
2. The employment hours for each unit process are calcu-
lated in each of the relevant geographical regions.
3. An overall employment table is calculated based on the 
LCI and employment distribution between regions an 
unit processes by combining the data in Points 1 and 2.
4. The regional characterisation factors are estimated.
5. The characterisation result, which is, by definition, the 
Societal LCA, is calculated from the geographical em-
ployment data and characterisation factors.

The method developed herein focuses on the work hours re-
quired to meet basic needs. It is important to label this type of 
societal life cycle assessment as an LCI-based concept wherein 
labour hours are used as the single variable in the calculation, 
much as a monetary unit, such as Euro is applied in Environ-
mental Life Cycle Costing. Therefore, the societal life cycle 
assessment proposed is micro-economic in nature, in that it 
examines the effect of product substitution on the state of 
average workers in countries where the product life cycle 
has an effect. It differs from the, more macroeconomic so-
cial assessment, in that the effect of government programs is 
covered explicitly in social assessment and implicitly, via 
overhead and taxes, in societal life cycle assessment.

2 Calculation Procedure

Societal life cycle assessment, as presented herein, assumes 
that an LCI is available or will be obtained as part of the 
analysis. It makes the critical assumption that the individual 
unit processes within the LCI can be decomposed into re-
gional, or often national, labour statistics, and, with these, 
some of which are calculated via correlations, as is also the 
case in estimation fields, characterisation factors are calcu-
lated. These characterisation factors are obtained by trans-
forming the labour hours via general, case-independent, sta-
tistics. As Societal life cycle assessment applies the same 
system boundaries and functional unit as LCA, the unit pro-
cess concept is also relevant. However, whereas in LCA the 
process tree is built up from connected unit processes with 
inputs (e.g. raw materials, energy and water) and outputs 
(e.g. intermediate products, emissions into air, water , soil, 
and co-products) in Societal life cycle assessment working 
hours are the relevant input. Furthermore, although employ-
ment hours have the advantage that they can be aggregated, 
one requires the employment hours per inventory element, 
per stage and per geographic region as will be shown in 
Sections 2.2 and 3.2. Total life cycle employment, if non-
transparent, would not be a reasonable proxy.

As a qualitative example, the elements from the LCI, such 
as fossil fuel, electricity, as well as air and water-based emis-
sions, to name just a few, are converted into labour hours. 
This conversion takes an element, such as rolled aluminium 
sheet, to use an example, and examines the hours required 
for extraction, transport to the production site, production, 
transport to the consumer, use and ultimate disposal. Some 
of these labour hours must, themselves, be divided between 
countries (e.g. if the Al source is in two countries). Further, the 
production and use are likely to be in different regions. From 
this newly based set of ‘employment-inventory’ tables one can