ASU SCHOOL of SUSTAINABILITY

ARIZONA STATE UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

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Will defend his dissertation

Addressing Uncertainty and Variability in 'Attributional' Life Cycle Assessment (LCA)

Abstract

'Attributional' Life Cycle Assessment (LCA) quantitatively tracks the potential environmental impacts of international value chains, in retrospective, while ensuring that burden shifting is avoided. LCA is increasingly becoming an influential decision-making tool in applications that include business decision-making (design, supply chain optimization, marketing, etc.), purchasing policy by retailers, assessing alternatives (technologies, consumer products, fuels, transportation modes, etc.), and identification of areas that require further research. While the pervasive use of LCA towards sustainable development is encouraging, there are numerous issues relating to uncertainty and variability in LCA that affect its reliability and credibility. Hence, decision-makers are wary of making decisions using the conclusions and recommendations provided from LCA's. We are at a juncture where some part of the future research in LCA needs to be guided towards increasing its reliability and credibility for decision-making, while utilizing the existing framework of LCA as established by ISO 14040 and ISO 14044.

In this dissertation, I reobserve the important but inconsistent topic of uncertainty and variability in 'attributional' LCA, and contribute to its quantitative assessment.

Firstly, the current progress on addressing uncertainty and variability in life cycle assessment is consolidated. It is evident that sources of uncertainty and variability exist in the following areas: ISO standards, the supplementary guides, software tools, life cycle inventory (LCI) databases, each of the four methodological phases of LCA, and use of LCA information. One source of uncertainty and one source of variability is selected and addressed.

The use of surrogate LCI data in lieu of missing dataset(s) or data-gaps is a source of uncertainty. Despite the widespread use of surrogate data, there has been no effort to (1) establish any form of guidance for the appropriate selection of

surrogate data and, (2) estimate the associated uncertainty with the choice of a particular surrogate. A formal expert elicitation-based methodology to select the most appropriate surrogates and quantify the associated uncertainty has been proposed and implemented.

Product evolution in a non-uniform manner is a source of temporal variability that is presently not considered in LCA modeling. In this case, outdated LCA information will dampen the current demand to use LCA information for purchasing-related communication with consumers, buyers and other stakeholders. Given that variability cannot be reduced, the sources of product evolution are identified, generalized, analyzed and their implications (individual and coupled) on LCA results are quantified. Thereby, facilitating decision-making under uncertainty.

Finally, recommendations are provided for the advancement of robustness of 'attributional' LCA, with respect to uncertainty and variability.

Thursday, April 14th, 2016
10:00 am
CAVC 331

Faculty, students, and the general public are invited.

Supervisory Committee:
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