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A UNIVERSAL FOOTPRINT DEFINITION: A CRITICAL NEXT STEP TO SUPPORT WIDESPREAD COMMUNICATION OF LCA DATA

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ABSTRACT

Life cycle assessment has traditionally been used to support professional decision-making where an LCA expert usually assists with interpretation of the complex impact category indicator results, potential trade-offs and uncertainties. This has changed with the emergence of footprint-style indicators which are often communicated widely to an audience which is remote, largely non-technical, and unable to benefit from first hand support in interpretation. To support the emergence of coherent footprint indicators based on LCA, we argue the need for a universal footprint definition. Specifically, footprints should not be viewed as simply new names for existing impact category indicators based on the Area of Protection paradigm, but rather as indicators which address specific environmental concerns of broad community interest.

INTRODUCTION

In recent years there has been a proliferation of environmental and social indicators termed footprints (Table 1) and the communication of footprints has become commonplace. Terms like *carbon footprint*, *water footprint* and *environmental footprint* have become part of ordinary language in many countries, no longer exclusively part of the vernacular of scientists and professional decision-makers.

This development represents both an opportunity and a threat to the LCA community. On the one hand, footprints are a means of bringing life cycle thinking and life cycle data into the mainstream and thereby greatly expanding the LCA community's sphere of influence. In addition, the progression toward a family of footprint indicators (Niccolucci et al., 2010; Galli et al., 2012; Fang et al., 2013) is better aligned with the intention of LCA to assess all of the relevant environmental burdens and avoid the unintended consequences which can occur when focusing on a single aspect, such as GHG emissions alone, i.e. carbon footprint (Finkbeiner, 2009).

On the other hand, we express concern that many of the so-called footprint indicators are not based on the well-established principles of LCA (e.g. ISO 14040, 14044), that there are problems of inconsistency and overlap of methods, as well as challenges for interpretation

when groups of footprint indicators are presented together (e.g. ecological footprint, carbon footprint and virtual water footprint). Even within the LCA community, there is no common understanding of what defines a footprint indicator and the relationship of footprints to existing life cycle impact category indicators is unclear.

In this presentation, based on a recent column in *Journal of Industrial Ecology* (Ridoutt and Pfister, 2013b), we argue the need for a universal footprint definition which will provide guidance to support the evolution of a coherent family of footprint indicators based on LCA. This is regarded as a matter of urgency to meet the demand for publicly communicated environmental product information.

Table 1. A selection of footprint indicators reported in the scientific literature (Čuček et al., 2012).

Agricultural land footprint	Financial footprint	Nitrogen footprint
Biodiversity footprint	Fishing grounds footprint	Nuclear energy footprint
Blue water footprint	Food to energy footprint	Phosphorus footprint
Built-up land footprint	Forest footprint	Poverty footprint
Carbon footprint	Fossil energy footprint	Renewable energy footprint
Chemical footprint	GHG footprint	Social footprint
Climate footprint	Grazing land footprint	Solar energy footprint
CO2 footprint	Green water footprint	Waste footprint
Corruption footprint	Grey water footprint	Water availability footprint
Crop land footprint	GWP footprint	Water footprint
Ecological footprint	Health footprint	Water pollution footprint
Economic footprint	Human footprint	Water scarcity footprint
Emission footprint	Human rights footprint	Water stress footprint
Energy footprint	Land footprint	Water supply footprint
Environmental footprint	Land use footprint	Wind energy footprint
Exergy footprint	Methane footprint	Work environmental footprint

FOOTPRINTS VS EXISTING IMPACT CATEGORY INDICATORS

LCA, with its complex models and indicators, has traditionally been used by professional decision-makers, often with the guidance of an LCA expert. This changed radically with the advent of the carbon footprint whereby LCA results entered the mainstream (Weidema et al., 2008) in response to the broad community concern about climate change. While there exists a variety of carbon footprint calculation protocols (e.g. BSI, WRI/WBCSD, Japan METI, ISO), the underlying impact assessment model is the same as for the global warming midpoint impact category indicator. Conveniently, in the case of climate impact, there is one midpoint indicator relevant to all environmental impact pathways.

However, this is not the case for the water footprint. There is no analogous midpoint for water use that is relevant to all of the many potential impact pathways associated with water consumption and degradation. This means that when LCA is used to perform a comprehensive assessment of potential water use impacts a profile of impact category indicator results is produced. This profile may be useful for reporting in the traditional

manner to professional decision-makers. However, we argue that a single result reported in an intuitively meaningful unit (similar to the carbon footprint) is needed when reporting to the wider community who generally lack the interest and technical ability to study a profile, yet are increasingly concerned about water stress. Such a solution has recently been presented by Ridoutt and Pfister (2013a) whereby the water footprint is reported as a parameter obtained after weighting using the ReCiPe endpoint modeling system (Goedkoop et al., 2009), with the result subsequently translated into units deemed to be relevant for public communication (i.e. liters of water consumption equivalents [L H₂Oe]). This approach could even possibly be a guide for other footprint indicators where the issue of environmental concern is complex and requires multiple environmental mechanisms to be modeled (e.g. land use footprint).

We propose that, in the LCA context, footprints are best defined as parameters which specifically address environmental concerns of broad community interest and are purposed for mainstream product and organizational environmental reporting. In some cases, these parameters will align with existing life cycle impact category indicators. However, in other cases they will not since the lens through which the community views environmental protection is not generally aligned with the Area of Protection framework which guides classification and grouping of impacts in traditional life cycle impact assessment. Loosely applying the term *footprint* to any life cycle impact category indicator result (many of which are poorly suited for mainstream dissemination) and profiles of complex indicator results would not appear to be helpful in engaging the broader community in life cycle thinking.

CONCLUSIONS

Footprints are emerging as an important mode of communication of environmental information to the wider community. We argue the need for a universal footprint definition to guide the evolution of a coherent family of footprints based on LCA. These footprints should not be constrained by the current Area of Protection paradigm. Instead they should specifically address environmental concerns of broad community interest. The popular interest in footprints represents an important opportunity to take LCA into the mainstream. The risk of inaction is that the community's interest in footprints will be met in less satisfactory ways by others working outside or on the periphery of LCA. The current proliferation of footprint indicators is evidence that this is already happening and some of these footprints report results which are in conflict with LCA.

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