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SOCIETAL LCA

The assessment of positive impacts in LCA of products

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Abstract

Purpose The objective of this paper is to open a discussion on the implications and challenges of including positive impacts in LCAs of products and to propose a set of criteria for their inclusion in LCA in general and in the Oiconomy system in particular.

Methods Using the existing literature, guided by the recent reviews by Di Cesare et al. (2018), Petti et al. (2016), and Ekener-Petersen et al. (Int J Life Cycle Assess 23(3):1–13, 2016) and our own experience and logic, we assess ethical and practical issues, shortcomings, potential inconsistencies, and problems of inclusion of positive impacts and propose criteria for inclusion of positive impacts in LCA.

Results Discussed in relation to the inclusion of positive impacts in LCA are the conflicting descriptive and prescriptive character of LCA, the inclusion of internalities, considering "absence of negative impacts" as positive, measuring by status or by change and the therewith involved temporal scope, moral consequences of comparing positive and negative impacts to different stakeholder groups, the requirement of a capacity-raising character and maintenance of a positive impact, rebound effects, R&D, background and foreground data on positive impacts, and the inclusion of employment and product utilities as positive impacts. Based on this assessment, we propose a set of criteria for the assessment of positive impacts in life cycle assessment in general and especially of positive contributions in the "Oiconomy system".

Conclusions This study demonstrates several serious ethical and practical issues and challenges related to inclusion of positive impacts in LCA. An especially difficult question is how to interpret the economic concepts of "externalities" and "internalities" in relation to LCA. A special definition of in- and externalities for LCA purposes is proposed. The importance of a "capacity-raising" character of a positive impact is demonstrated, but also some of the difficulties of distinguishing capacity raising from maintaining the current status. Important outcomes are that for a consistent LCA, inclusion of most internalities and absence of negative impacts must be dissuaded, which also applies to employment and wages unless without a range of additional criteria. Great caution must be taken with inclusion of product utilities, comparing the positives for one stakeholder group with the negatives for another and mixing measurement by status with measurement by change.

Keywords LCA · S-LCA · Positive impacts · Externalities · "Oiconomy project"

1 Purpose

The purpose of this paper is twofold: (1) to open a discussion on the implications and challenges of inclusion of positive impacts in life cycle assessment of products and (2) to make a preliminary proposal for inclusion of positive impacts in the Oiconomy system, which can be adapted based on potential reactions to this paper.

The main reason for opening a discussion is the recent development to include positive impacts, especially in S-LCA, with, in the opinion of the authors of this paper, risks and consequences that need discussion.

The main reason for the assessment of inclusion of positive impacts in the Oiconomy system needs a short explanation of that system. The Oiconomy system is a preventative costs–based life cycle assessment, under development by the authors of this paper, designed to transfer a monetary measure of (un)sustainability, the Eco Social Cost Unit (ESCU), through the supply chain of products (Croes and Vermeulen 2015). A

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standard, comprehensively addressing all aspects affecting the sustainable development goals, leads supply chain actors to collect ESCUs from suppliers, calculate their own contribution in a standardized way, and transfer the aggregated result to the next actor. The system imitates standard economic bookkeeping and internal cost build-up, for the hidden externalities. Because the ESCUs are equal to the costs of preventing impact, the sum of the standard economic costs and the ESCUs represents the costs of the sustainable version of the product. The standard enables verification of the data by means of certification, which thereby become foreground. The Oiconomy system challenges supply chain actors to gradually evolve to calculate their own foreground preventative costs, e.g., by investment proposals, and use the cost distance to the sustainable version of the product (without margin) as measure of sustainability. Only in the absence of actual preventative costs, default background data are used, provided by a database. Because all data are aggregable, in the Oiconomy system, positive values can be effectively used to mitigate the combined ESCUs for a product, which makes the inclusion of positives in this system extra attractive, but also includes risks.

Because the Oiconomy system is intended to be comprehensive, including all the 3 pillars of Planet, People, and Prosperity and because the ESCUs of all aspects are aggregated within the supply chain, it does not distinguish terms like "E-LCA" and "S-LCA" but covers all environmental, social, and economic aspects related to the 17 Sustainable Development Goals and all the aspects included in ISO 26000 in an equal way.

In the following, we will use the terms E-LCA and S-LCA where we cite articles concerning the relative type of LCA or deal specifically with either E-LCA or S-LCA. Where we use the term "LCA," the discussed matters and arguments are universally applicable to both E-LCA and S-LCA. In the following, the words "positives" and "negatives" replace "positive impacts" and "negative impacts."

2 Introduction

The UNEP Guidelines for S-LCA (Benoît Norris et al. 2009, p.100), define S-LCA as "a social impact assessment technique that aims to assess the social and socio-economic aspects of products and their positive and negative impacts along their life cycle". Because at the time of writing this paper the UNEP Guidelines are in the process of updating, we will further refer to these as "original UNEP Guidelines." Di Cesare et al. (2018) and Petti et al. (2016) provide reviews of publications including positive impacts, all of which are very recent, and Ekener-Petersen et al. (2016) provide an extensive discussion on the implications.

The original UNEP Guidelines also state: "An externality occurs when a decision within the value chain imposes costs or benefits on others which are not reflected in the prices charged for the goods and services being provided by the value chain," and "until now, no commonly accepted methodology for assessing internalities and externalities of the production of goods and services for 'people' and 'profit/prosperity' was available. That is precisely what the tool presented in these guidelines wants to deliver" (Benoît Norris et al. 2009, p.16). From this text, it is not clear if or how the original UNEP Guidelines intended to include both internalities and externalities for positive impacts. It is not even clear what is meant with the term "internalities," the economic concept of unwanted impacts of traded products, or the concept of product features, already monetized by economic transactions. In this paper, we will use the latter interpretation until we make a proposal for a better-specified definition for LCA purposes in Section 4.1.2. To date, the major body of both E-LCAs and S-LCAs assesses negative externalities. Naturally, the industry prefers positives that can be used as marketing tools and may find support in the argument by Di Cesare et al. (2018), p.417 that maximizing positive results might be more important than minimizing the damage originating from negative impacts. However, if positives are included in either S-LCA or E-LCA, there is a great risk that such arguments will be used to justify business as usual, greenwashing and reliance on technological solutions, and even that the credibility of the assessment is jeopardized. At the Shine "Net Positive" conference in Boston (Shine 2017), attended by the authors of this article, companies in the tourist business presented their positive labor conditions without mentioning that most of their customers need air transport. However, the 2019 user guide of the Net Positive Project states: "Focusing on areas of biggest impact and opportunity, a company inevitably must consider shifts to its core business or operating model" (Net Positive Project 2019, p.14).

In literature, articles appear, descriptively correct, but the ethics of which must really be questioned (see Section 4.1.1). Also, Ekener-Petersen et al. (2016), in their discussion of the implications of assessing positives in S-LCA, do not systematically discuss the ethics and consequences of inclusion of positives in S-LCAs, assess these against the underlying objectives of S-LCA, or propose criteria for inclusion of positives. Although the original UNEP Guidelines state that only those positive impacts beyond compliance to legal or other standards may be included, this limitation and the original UNEP Guidelines' distinction between internalities and externalities do not seem to be systematic criteria. Actually, literature describes few systematic criteria for which positive impacts to include and which not.

3 Methods

Recently, three reviews were published on the assessment of positive impacts in LCA (Petti et al. 2016; Ekener-Petersen

et al. 2016; Di Cesare et al. 2018). We checked for later publications by following their citings in Google Scholar and by searching for "positive impact" or "benefits" and LCA or "Life Cycle Assessment" in Google Scholar and Scopus and included one more relevant article for our assessment: Benoit Norris et al. (2020), on the net positive initiative. In Section 4, using the existing literature, guided by the reviews, but also by our own experience, we assessed and listed challenges, inconsistencies, and potential problems of inclusion positive impacts for the various mentioned categories and subcategories of aspects. For our assessment, we used both theoretical and practical considerations. In addition, we assessed if existing goals, standards, and interpretations are clear, lead to useful information, and if they can be misused, e.g., for greenwashing (Ramus 2005; Parguel et al. 2011; Stecker 2016). Because a consistent standard or guideline is lacking and that gap is exactly what this paper wants to address, we used our own logic. Based on this assessment, a set of criteria is proposed for the assessment of positive impacts in LCA in general and S-LCA in particular in Section 4.

4 Results and discussion

4.1 Challenges of inclusion of positive impacts in LCA

In their article, "Does the Production of an Airbag injure more people than the airbag saves in traffic?" Baumann et al. (2013), already in their title, compare the saved injuries to users of airbags with the inflicted injuries in the supply chain. Although we recognize that both these individual positive and negative impacts are descriptively relevant, there are serious ethical objections against comparison of negative impacts to one stakeholder group with the benefits for another group, especially in S-LCA. By definition, all marketed products and therefore all the involved activities in the supply chain have some positive effect, expressed by their market value. The goal of both E-LCA and S-LCA is to support decisions into the direction of sustainable development, but the underlying intention, is to help decision-makers reduce negative impacts to zero, especially to other stakeholders than the supply chain actors themselves. There cannot be any justification for saving one's life at the expense of another. In addition, in a broader perspective, such comparison does not make sense. Without food production, the total global population would die. Also, other industry sectors, like pharmacy, plastics, energy, construction, communication, and transport, could easily argue that their products have positive and even lifesaving impacts on human wellbeing. Di Cesare et al. (2018), p.417, state that "maximizing positive results might be more important than minimizing the damage originating from negative impacts." It is indeed undeniable that modern agriculture and industry improved human wellbeing and reduced famine and epidemics. But these also caused environmental and social issues, severe enough to exceed tipping points in earth or human resilience which could destroy much of the accomplished. Mankind has arrived at the challenge of achieving the same for all, without compromising the ability of any stakeholder groups to meet their needs. One basic difference between positives and negatives is that positive functions of a product are usually far better known than its negative impacts. Because the practical goal of both E-LCA and S-LCA is to fill this information gap for decision-makers (see also Section 4.1.2), and not to become a marketing tool for already known positives, in our opinion, the scientific community should be very cautious with the inclusion of positives in their assessments, and set criteria.

Literature is not very specific in defining criteria for positive impacts, using terms like:

- Negatives are "burdening" and positives an "unburdening" (Zore et al. 2017)
- "Providing a win-win situation" (Petti et al. 2014; UNDP 2015; Di Cesare et al. 2018)
- "Contributing to countries' improvement in Sustainability Development Goals (SDGs)" (Benoît Norris et al. 2009; Di Cesare et al. 2018)
- "Social improvements related to a previous situation, but beyond compliance (Petti et al. 2014)"

Such criteria are usually just loose arguments, potentially valuable, but also vague, sometimes confusing, incomplete or insufficient. For instance, the mentioned criteria considering "(un)burdening" and "social improvements related to a previous situation" lack a statement on a consistent reference point; a "win-win situation," by definition, occurs by any economic transaction and "contributing to countries' improvement in SDGs" may refer to both externalities and internalities. Petti et al. (2014, p.40) already showed that there is no shared definition of positive social impacts as part of the S-LCA methodology, which also applies to E-LCA. In our opinion, without a more systematic set of criteria, inclusion of positives in either E-LCAs or S-LCAs could make these vulnerable to creative marketing and greenwashing. Therefore, acknowledging the need to include positives in LCA in general, we made a more systematic assessment on the implications and challenges of inclusion of positives in LCA, before proposing a position, at least for the Oiconomy system, but probably as valuable for LCA in general.

4.1.1 The descriptive and prescriptive nature of LCA

In origin, LCA is a descriptive scientific analysis of the impact in the life cycle of a product, but as an applied science, its practical goal is prescriptive by providing information for decisions in the direction of sustainable development. The

Oiconomy system is emphatically prescriptive in its goal, but as much as possible based on analytical and descriptive research in its methodology and data.

In principle, descriptive science has no morality. But can LCA be purely descriptive? Already, the choice of aspects is influenced by moral considerations, and the choice of system boundaries depends on the practitioner's objective. The ISO 14040 standard on LCA reflects the different scientific characters of LCA. Its title: "Environmental management—Life cycle assessment—Principles and framework," already explains the intended use of LCA in environmental management, which tends to be prescriptive. The determination of the functional unit and system boundaries may be considered a means of defining the study and belonging to the analytical phase, but in its choices can be highly subjective and prescriptive. The next phase, the Life Cycle Inventory analysis, is purely descriptive, but the following life cycle impact assessment can be both descriptive and prescriptive, depending on the assessment methods. The interpretation phase and the paramount important requirement of transparency as stated in ISO 14040 are purely prescriptive (ISO 2006a). In E-LCA, aggregation of positive and negative impacts makes sense provided that the impacts are not spatially specific, but in S-LCA, the descriptive and practical characters of the assessment become wringing and grinding at the inclusion of positive impacts. For instance, a comparison of a positive impact on one stakeholder group with a negative impact on another stakeholder group, as described above, makes descriptive sense but is prescriptive utterly immoral. Actually, especially in S-LCA, comparing similar social impacts with different size or direction by definition implies a redistributive effect between groups of people and thus leads to intrinsic ethical issues. The following sections are based on the prescriptive and therefore ethical goal of sustainable development.

4.1.2 Externalities—internalities

In the definition of the original UNEP Guidelines, "externalities," or in the words of Pigou: "divergences between private and social costs" (Pigou 1920. p.159), "occur when a decision within the value chain imposes costs or benefits on others which are not reflected in the prices charged for the goods and services being provided by the value chain" (Benoît Norris et al. 2009, p.16).

Negative externalities are abundant, the major subject of current LCAs, and often hidden. One could even argue that one of the major shortcomings of the current economy is that it favors those actors that are best in transferring hidden costs to external parties. Internalities, as first defined by Herrnstein et al. (1993) p.150, "occur when a person underweights or ignores a consequence of his or her own behavior for him- or herself." In economic terms, internalities are included in the product's price because the consumer is assumed to have rationally considered all private impacts and costs (Gruber 2014, p.52). A classic example of a negative internality in these economic terms is the health impact of smoking. This, in our opinion, poses a definition problem for LCA purposes. The buyer of the cigarette does not rationally buy the cancer but unwillingly gets it as a side effect of the smoke. Gruber (2002), p.54 even argues that in practice, "tomorrow's self bears the costs of today's self," almost as an externality.

Confusing and impractical for LCA purposes is also that in economic terms, an internalized externality is not an "internality." For example, Allcott and Sunstein (2015), p.6, use the two concepts additional to each other. Various authors on negative internalities show the similarities in effect between using measures such as taxation against both externalities and negative internalities (e.g. Allcott et al. 2011, 2012; Gruber 2002; Marron 2015).

Key in the discussion is the question if the buyer is well informed about the future costs and effects of his purchase. Without rational consideration of negative consequences of a transaction, defining the resulting negatives as internalities is at least confusing. The goal of LCA is to provide information for a better consideration of sustainability in decisions. Therefore, for LCA purposes, we would rather consider the cancer by smoking as an externality instead of as an internality. The same applies to the noise of tools and machines and even to the health impact of mycotoxins or pesticides in food. We mention the last example because there is a difference between buying your own misfortune knowingly or not, because in the latter case, the economic assumption of rational consideration of the issue is false, and for LCA studies, reliably distinguishing between known and unknown features of a product is not feasible. The safety of a product's utility is the producers' responsibility and should be included in the price, which makes unsafety an externality. In addition, private costs regularly become social costs, e.g., by community health care, loss of labor, or via insurances, whose effect causes a divergence between private and social costs.

Positive externalities have a totally different nature. Only beneficial impacts that are not included in the price agreed in the seller-buyer transaction can be characterized as positive externalities. Literally taken, any commercial activity leading to a seller-buyer transaction is an internality because the consumer pays for its benefit, with the consequence that the inclusion of positives in LCA would result in a kind of double counting, which should be avoided in LCA, according to ISO 14044 (ISO 2006b, p.19). If a product that the consumer consciously decided for is included in an LCA, it is one time assessed in the standard economy in the transaction decision and one time in the LCA. On the contrary, externalities, by their nature, lack the assessment in the standard economy, but are hidden imposed, which the LCA intends to reveal. Positives are also far less hidden than negatives, because companies do not tend to emphasize the latter in their marketing.

And when a LCA uncovers a hidden benefit, thereafter advertising it theoretically makes it an internality, serving the sales of the product and informing the buyer. The disadvantage of this point of view is of course that it counteracts advertising that could accelerate the development of positives that are real externalities. Transparency on positive and negative internalities should be equal, but this is against the natural interest of businesses. Characterizing aspects as internalities or externalities is not always easy. For instance, the aspect of community education is an externality for a mining company but an internality for a paid private school. Paying a fair wage to a cocoa farmer in Ivory Coast is not an externality, but helping him to sustainably raise his sustainability, quality, and yield, described by Porter et al. (2011), p.5, as a "shared value," is.

To avoid the confusion about the term internalities, we propose to, for LCA purposes, to distinguish two types of positive internalities: type 1: Benefits considered by the transaction partners and included in the price, and type 2: Benefits, not considered, neglected by the transaction partners or underestimated and not affecting the price. Type 1 internalities, including all resources and costs leading to the product and its price, in our opinion, do not belong in LCAs. In principle, type 2 may be included, but examples are difficult to find, because by nature, these are often unknown, but one example would be the social contacts belonging to a job. Table 1 presents our resulting definitions of positive and negative internalities and externalities for LCA purposes, as an alternative for the table shown in the original UNEP Guidelines (Benoît Norris et al. 2009, p.17) and applicable both on environmental and social aspects. However, it remains unclear what the original guidelines have meant with the term internalities in their wish to deliver a commonly accepted methodology for the assessment of internalities and externalities (Benoît Norris et al. 2009, p.16).

4.1.3 Measurement by status or by change

A recent development is the "Net Positive Project," with participants like Dow, CAP Gemini, Levi-Strauss & Co, and Kingfisher (Net Positive Project 2019). Advocates argue that only abatement of negative contributions is not enough and that companies should strive to have a larger positive than negative contribution. (Forum for the Future 2019; Hollender 2019). An article in the Guardian defines net positive as "Businesses have impacts on the environment and society. Some are negative, some positive. For a company to be net positive, the latter need to outweigh the former" (The Guardian 2013). Benoit Norris argues: "Net positive = Handprint − Footprint" and could be measured by the inclusion of positive contributions in S-LCA (Benoit Norris et al. 2020, p.36). "Footprint" is defined as the negative impact of an actor by sustaining himself and "handprint" as the positive changes outside of the actors' footprint (Norris 2019) and therefore as externalities. Norris argues that there are two ways to create handprints: "Be a cause of reduction of some other actors' footprint," and "create positive impacts which are measurable in footprint units." The Net Positive Project challenges companies to "put back more than you take out" (Norris 2019), but combining measuring by status (LCA, footprint) and by change (handprint), as in the formula of a Handprint − Footprint, presents caution, especially in S-LCA. Norris describes criteria for combining handprints and footprints:

1. The use of the same baseline for footprint and handprint
2. The shared responsibility for footprints and shared credit for handprints if several actors are involved
3. The need of setting a time scale for future impacts (Norris 2019)

An equal baseline is needed for a comparable scale for the distance to the goal, but "business as usual," currently the most used baseline in business reports, provides no comparable baseline. In addition, a shared responsibility and credit for negatives and positives is needed to avoid double counting at the probably best opportunity to become net-positive, namely, to be the cause of a positive change at suppliers beyond the company purchased products of services. However, for correct quantification, it will be very hard to divide the shared credit of such positive impact on a supplier between that suppliers' different customers and the improving actor himself. Here, we see a clear advantage of the Oiconomy system where all positives and negatives are transferred to the next actor, so automatically, responsibility for negatives and credit for

Table 1 Positive and negative internalities and externalities for LCA purposes

		Internality	Externality
Positive	*Type 1*	*Benefits considered by the transaction partnersprint*	**Benefits to others than the transaction partners**
	Type 2	**Benefits not considered by the transaction partners and not affecting the price (unknown, underestimated)**	
Negative	**Unknown, underestimated, or ignored harm to the transaction partners**		**Harm to others than the transaction partners**

Italics not to be considered in LCA. Bold text to be considered in LCA

positives are shared by the supply chain without the risk of double counting. An LCA or footprint measures the current status. For quantifying a change, a time frame is required for how long the actor may claim credit for a positive change. However, because future developments and impacts are uncertain, current assessments about that time frame will be inherently uncertain. In addition, without a solid reference point, such credit does not hold if an even better alternative enters the market.

In our opinion, the only possibility for a sensible assessment of change is by regular repeated assessment of the status. For measurement by change without such repetition, criteria are required for the temporal scope and for the maintenance of the improvement (see Section 4.1.7).

Another important issue is the word "net" if not all sustainability aspects are included. In principle, the word could be used with validity for separate aspects, which indeed is the current focus in sustainability reports by the involved companies. The net positive initiative as such, striving to become more restorative than damaging, is in our opinion a valuable step. It creates ideas and development and increases the chance that stakeholders hold the companies to their promises. However, current company reports on positives still are narrative and focused on achieved and planned improvements, lacking a comprehensive, reliable, and objective assessment of their status (The International EDP System 2019). The last issue we want to mention is that a measure by change without a comparable reference point loses the ability to compare companies and products. In fact, measured by change, a bad performer has a better chance to become net positive than a good performer, and, in our opinion, a change that is not enough to accomplish the timely end-result should not be considered a positive. Therefore, for transparency reasons, a handprint should not be presented without the footprint or in other words the positives never without the negatives and a change never without the status. Concluding, we argue that the best way of measuring by change in LCA is by repeated assessments of the status.

4.1.4 Absence of a negative impact or foreground data

Scholars agree that the absence of a negative should never be considered a positive in S-LCA (e.g., Petti et al. 2014, p.39). Although we did not find a reference, we believe that this also applies to E-LCA. If the negatives are properly assessed, there is no need for putting another value on their absence. In addition, positives are not always easy to distinguish from the absence of negatives. For instance, how to distinguish between the suggested (Di Cesare et al. 2018, p.407) positive aspect of a healthy building environment from the absence of issues like weak structures, noise, bad ventilation or lack of light, proper maintenance, and fire prevention. This requirement for LCAs distinguishes it from economic concepts of positives. For instance, Porter and Kramer, in their concept of shared value, describe many examples of shared value which actually are better characterized as absence of negatives. See Porter et al. (2011).

Current LCAs on negatives are usually based on background data, using default data from databases. Default values always include the risk that a specific case does not comply with generic rules. Because of the risks of greenwashing and the need that positives must be considerably better than average, we argue that in absence of demonstrable foreground data, positives should not be included in LCAs.

4.1.5 Temporal scope

For both positives and negatives, certainty decreases with the temporal scope. Long-term negative impacts of short-term positives are often overlooked or underestimated. One incident or one thought may change and regularly has changed the course of history. Many new technologies exist from positive opportunities but later develop serious negative consequences. Fossil fuels were at the source of the industrial revolution but much later also of climate change. Intensive agriculture was at the source of a huge expansion of food availability but now seriously endangers biodiversity. The internet provided world-changing communication opportunities but later also internet criminality, terror, and fake news. Business as usual, regularly labeled as positive as expressed by the sentence "never change a winning team," proves unsustainable. Therefore, before characterizing something as positive, as much as possible, also its long-term potential negative impacts should be assessed. However, in practice, this will prove very difficult, because that requires a view into the future. Who in the nineteenth century could have expected climate change and who in the eighties of the twentieth century internet criminality? S-LCA should be based on performance reference points (PRPs) that preferably are based on legislation, international standards, or the sustainable development goals. These usually are based on scientific knowledge on the long-term impacts of for instance child labor or poor working conditions. But desperate victimized workers and communities themselves often have short-term needs that make them accept issues like child labor, e.g., Dewulf et al. (2013). In addition, the victims do not always know the long-term effects of the aspects that are burdening on them or have cultural reasons to disagree with the impact. S-LCA scholars may find themselves in a dilemma between adhering to international and western standards and lowering standards for low-income countries. In the first case, the assessments may be accused of patronizing and unfit for low-income countries, and in the second case of inconsistency. Concluding, because of the huge long-term uncertainty of the negative consequences of seemingly positive developments, LCA

practitioners should be extremely cautious with including positives that are based on new developments.

4.1.6 Different affected stakeholder groups

In our introduction, we already mentioned the ethical issue of comparing positive impacts for one stakeholder group with negatives for another. Questions arise like: "do the interests of the many outweigh those of the few," "do the interests of the rich outweigh those of the poor, or the interests of shareholders those of the workers," "do social positives outweigh environmental negatives, or the reverse," and "may improvements in the working conditions in a coal mine with great effect on climate change, be considered as positives"?

The concept of sustainability is defined by the Brundtland statement: "sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations World Commission on Environment and Development 1987). In our opinion, especially for S-LCA purposes, this statement should be complemented with "sustainable activities meet the needs of one stakeholder group without compromising the ability of other stakeholder groups, including future generations, to meet their needs." In the Oiconomy system, international standards are used as PRPs, and if those are not available, we propose to use the performance on an aspect set by the methods of the 20% best performers (mostly countries). Ekener-Petersen et al. (2016) consider the ethical aspect of different effects as a scientific challenge that may be solved, e.g., by weighting methods, which would imply a weighting between the interests of current and future generations. However, we emphasize extreme caution in comparing or aggregating positives and negatives with any chance that different stakeholder groups are affected, although we recognize that this is a prescriptive point of view (see Section 4.1.1).

Another question raised by the Brundtland statement in combination with the here discussed subject of positives is if we should interpret "without compromising the ability of other stakeholder groups" for each single aspect separately, or may we compensate one with another aspect? This is the same question as "should we go for strong or for weak sustainability?" For the Oiconomy system, we choose for strong sustainability for all categories of aspects, which means that the intention is that in the Oiconomy system, ESCUs are transferred for all aspect categories.

4.1.7 Maintenance or capacity raising?

Various authors argue that if the "capacity," such as a raised ability of a subsistence farmer to maintain a decent income, is not raised by a product or activity, its positive character is questionable (e.g., Benoît Norris et al. 2009; Garrabé et al. 2014; Ekener-Petersen et al. 2016; Petti et al. 2016). In our opinion, this means that only capacity-raising activities can be considered positives and not only maintaining of an aspect at the same level. Two related questions about maintenance should be considered. First: Should a positive be long-term sustainable? And second: Can maintaining a beneficial aspect at the same level be a positive in LCA? The answer to the former question is rather easy. An improvement does not make sense if it is not maintained. For instance, planted trees as compensation for flying should not be considered positive without long-term protection of the planted forest, because of the long-term risk that the investment will be in vain. But also the latter question should in our opinion be answered "no." A good example is education. Without a certain level of education, the capacity or education capital of a country decreases. Without maintenance, it will be lost by forgetting, pensioning, and death of people and should not be considered a positive. Others, however, may use the same argument that without maintenance, things will deteriorate, and therefore consider maintenance as a positive. We oppose the latter reasoning for two reasons: (1) Lack of maintenance" should be assessed a negative, just like it would be considering occupational health and safety aspects of equipment in industry. (2) Maintenance as a positive would create a far too big and common positive. A challenge in the assessment of positives will be to determine which part of an activity is maintenance and which part capacity raising. The same difficulty applies for instance to commercial R&D activities on environmental or social improvements, where often a part of the activities is for maintenance or efficiency purposes (see also Section 4.1.11). We stress this point of maintenance because if positives are included in LCA, very easily, maintaining a certain status as business as usual may be characterized as positive, this way undermining the credibility of life cycle assessment as tool for sustainable development.

A last argument in this section we like to mention is that activities that are the natural obligation of governments with sufficient capacity cannot be positives for commercial bodies. An example is building infrastructure in developed countries.

4.1.8 Rebound effects

The rebound effect is caused when money saved by impact-reducing goods or measures (such as less driving and insulation of houses) is spent on other CO_2-emitting goods and activities. Therefore, positives may not be as effective as they seem. Petti et al. (2018) give the example of the use of 3D printers saving transport and waste, but also saving costs which will be spent on other things. There are countless other examples, such as to use Skype instead of traveling to a friend abroad and spending the saved money on a holiday. In fact, a large part of the saved money on anything will be spent elsewhere. Druckman et al. estimate at unchanged household preferences the rebound effects on carbon emission–mitigating

measures in the UK at about 34% (Druckman et al. 2010, p.24). Rebound effects reduce the effectiveness of impact-mitigating measures by alternative use of money as result of an impact-reducing measure. In literature, the rebound effect usually refers to the compensating negative effect on one specific environmental aspect, usually related to resource and energy use and climate change. In our opinion, the interacting impacts of different environmental and social aspects need equal consideration. However, because little quantitative data are available on interacting effects of the different sustainability aspects themselves, extension to social aspects and inclusion of interactions in the rebound effect in LCA currently seems a bridge too far. Usually, the concept is used for saved money used elsewhere but in principle can also work the other way, causing impact by reduction of the available money. For instance, an increased price of diesel, meant to mitigate carbon- and particulate matter emissions of cars, may lead to spending less on healthy food and thus to increased malnutrition. Our conclusion on dealing with the rebound effect is that, although causing potentially significant reductions of the efficiency of positives, far more research is required for inclusion in LCAs with reasonable certainty.

4.1.9 Employment a positive?

To date, the most commonly used positive in S-LCA studies is local employment (Ekener-Petersen et al. 2016; Petti et al. 2018). Most employment, however, is a type 1 positive internality, because the costs are included in the price of the product. In addition, one may seriously question if employment at sub-fair wages, or favoring privileged groups because of corruption, may be called a positive or a negative impact. In addition, in a competing world, the gained employment may be at the expense of another employer or in the international context, of another country, which even may be a more responsible employer. In fact, the impact of unsustainable behavior on competitors, a forgotten stakeholder group in the original UNEP Guidelines, may be considered a cause of "the race to the bottom" and major contributor to all unsustainability. The global labor share is over 50% of the gross global product (ILO Department of Statistics 2019, p.26). That means that if all employment would count as a positive, a huge positive would be created, with the danger to be used for compensating and justifying negatives. Most employment is maintenance of business as usual, and distinguishing what employment would raise a regions' capacity and what not seems very difficult. And last, in a healthy economy, loss of employment in one sector is usually compensated by growth in another sector. If employment would be characterized as positive, it should, in our opinion, at least comply with the criteria, described in our examples of positives in S-LCA in Section 5.1.

In practice, these criteria would mean that employment would seldom lead to a positive assessment in low-income countries, which is in contrast to one of the reasons of including positives in S-LCA (Benoît Norris et al. 2009, p.76). The same applies to wages, which are also frequently mentioned as possible positives (Benoît Norris et al. 2009; Jørgensen et al. 2010; Petti et al. 2014; Ekener-Petersen et al. 2016; Di Cesare et al. 2018). Because of all these reasons, we recommend not to characterize employment and wages as such as positive in S-LCA, without other criteria.

Aforementioned already was that employment for the activities of an organization is a type 1 positive internality, not to be included in S-LCAs. On the other side, we like to mention an example of an employment that is a positive externality, consisting of the "second-order" employment expansion in the communities around the organization's operations, not concerning the local suppliers (type 1 positive internalities), but due to the local expenditures of employees. But this expansion may only be assessed as a positive if it can be demonstrated that it gives a sustainable net positive employment in the local community, which is not the case in the presence of sufficient local competition or at a high local employment rate. In addition, because for quantification of this local expenditure-dependent effect, expenditures on region-imported goods should be subtracted from the locally gained incomes; this positive can only be applied for poor and closed communities, for which data availability will probably be limited. Therefore, as aforementioned, we propose to assess as positive the employment in the 20% poorest countries only, and only if the aspects of the fair minimum wage (Croes and Vermeulen 2016b) and fair inequality (Croes and Vermeulen 2016a) are properly included in the assessment.

4.1.10 Utility of products

Life cycle assessments on negative impacts of product utilities are quite common, such as on the emission of transport means. But every product also has a positive utility, which is the mere reason of its existence. Various papers (Baumann et al. 2013; Ekener-Petersen and Moberg 2013; Wilhelm et al. 2015) include utilities of goods as a positive impact. We already discussed our concerns about the Baumann case of airbags. But on the other side, the airbag was especially developed for a positive utility, which needs appreciation, just like windmills, solar panels, medicines, and food. Two types of users need to be distinguished: businesses and consumers. In business applications, the utility is appreciated by mitigating the negative impacts in the downstream supply chain. The effects will appear by less negatives in the assessment of these downstream products. In the Oiconomy system, which transfers data through the supply chain, inclusion of utility before the stage of the end-producer would cause double counting. For consumer utility positives, as explained in Section 4.1.1, we distinguish 3 groups:

1. Positive *utility-externalities*, benefiting others than involved in the economic transaction. An example, perfect for inclusion in an S-LCA, is a company purchased fire truck at the disposal of the community
2. *Type 1 positive utility-internalities* that are part of the considerations at a seller-buyer transaction. This group consists of the majority of product utilities, which do not belong in LCAs.
3. *Type 2 positive utility-internalities* that have not been considered and not affect the price. An example would be the private honey that a farmer obtains from a beehive that he purchased for pollination purposes. In principle, such positives could be included in an S-LCA, but, as the example shows, will by definition be irrelevant.

However, the utility of technology, which is especially intended for impact mitigation, such as a windmill, presents a more complex situation. We argue that R&D and installation of impact-abating technology are capacity raising and therefore the depreciation and interest are positives (see Sections 4.1.7 and 4.1.11), but the utility is not, because of the here-described reasons.

4.1.11 Research and Development

Several times aforementioned were R&D activities. These present extra difficult and contradicting considerations. Literally taken, R&D activities by commercial actors are type 1 positive internalities, which should not be part of LCA. This becomes very clear in the pharmaceutical industry, but also in information technology, where a major part of the price of the product is for financing the internal R&D costs. But on the other side, the Agenda 2030, formulated by the United Nations, stresses the importance of research to achieve the 17 SDGs (United Nations General Assembly 2015). Therefore, we argue that R&D activities that are really focused on sustainable development deserve a positive characterization. However, because it will be very difficult to determine verifiable and reliable criteria for quantification of the positive impact of R&D activities, we propose to characterize R&D as positive for products and activities that are (almost) exclusively intended for sustainable development and are externalities or type 2 internalities. Examples would be the development of renewable energy or recycling technology and life cycle assessments themselves. We have no proposal yet for R&D activities that are less exclusively intended for sustainable development. We suggest to limit inclusion of positive R&D activities to well-defined contributions to one of the 17 SDGs, or more granularly, defined to the 27 midpoints as defined by Vermeulen 2018, p.24.

5 A proposal of criteria for positives to be included in LCA

By definition, the positive impact of products is automatically valued by their market price. Unfortunately, the hidden negative externalities are not. And unfortunately, there is no way to objectively weight the importance of the impact of different aspects, negative or positive. Even democracy is an insufficient weighting instrument, because future generations have no vote and short-term interests predominate. Even the original S-LCA guidelines admit that the inclusion of positives was influenced by negative perceptions of low-income countries considering S-LCA as "anti-development," insufficiently addressing their most significant short-term problems like poverty, unemployment, accidents, and other immediate issues (Benoît Norris et al. 2009, p.18).

But on the other side, just like the market does not value the hidden negatives, it may not value all positives enough to achieve the balance of human wellbeing for all, which in principle the "invisible hand" of Smith (1776) should do. Any commercial company would like scientific recognition, proof, and attention about its positive contributions. Therefore, inclusion of positives in LCA may help to get LCA accepted and applied by industry. Sustainability assessment of positives may help to focus on sustainable development and help politicians in decisions on which developments to support. In theory, it is possible that LCAs disclose yet unknown positives. And in our opinion, valuable use of LCA would be to assess the real positive value of features claimed as positive by the industry. However, inclusion of positives also presents a great risk. By nature, the industry focuses on unique selling points and getting the opportunity may give more focus on maximizing positives than on minimizing the negatives. Without rules on how and when to assess positives, LCA may be used for greenwashing and become a wild medium of seemingly scientific marketing arguments and justifications of negatives.

Therefore, in our opinion, inclusion of positives in LCA could be helpful, but for a credible LCA, a way must be found to overcome as much as possible the above-described issues and to develop criteria for positives in LCA. Based on the results of our assessment and our definitions of positive and negative internalities as presented in Table 1, we propose a set of core criteria for the assessment of positives in E-LCA and S-LCA. These criteria are meant for prescriptive LCAs with the purpose to support sustainable decision taking. Note that not all of the below-described criteria also apply to purely descriptive science. Thereafter, we will give a list of examples of concrete activities and products that, based on these criteria, could be characterized as positives.

5.1 Proposed core criteria for positives included in a prescriptive LCA

1. Positives must be externalities (Section 4.1.2), beneficial to stakeholders outside the seller-buyer transaction, or type 2 positive internalities. However:
   (a) Advertising a positive makes it a type 1 positive internality that should not be included in LCA. However, we suggest to exempt advertising Accreditation Council and/or ISEAL accredited certificates and other universally recognized means of evidence.
   (b) R&D activities (almost) exclusively intended for environmental or social improvements are positives if the envisioned results are beneficial also to others than those involved in the economic transaction. For the assessment of R&D activities that are less exclusively intended for sustainable development, we currently have no proposals, especially not for how to assess their externality share.
   (c) Products of which the utility is (almost) exclusively unburdening (e.g., solar panels) are positives. Only the capacity-raising investments (depreciation + interest) are positives, not the utility itself, unless that positive utility is free of charge. Note that for instance the utility of an electric car, measured by status is not unburdening, because its utility is driving.
2. Positives cannot be absence or mitigation of negatives (Section 4.1.4).
3. Positives are products or services, sustainably raising the capacity of a stakeholder group to meet their needs (Section 4.1.7).
   (a) Positives must perform beyond compliance stipulated by laws, international agreements, and certification standards (Benoît Norris et al. 2009).
   (b) Positives must raise the capacity of a stakeholder group to advance on one or more of the Sustainable Development Goals.
   (c) Positives must be sustainable and maintaining the achieved capacity at the higher level.
4. Positives have demonstrable capacity-raising impact on supply chain actors, exceeding the needs of the parties involved in the economic transaction (Section 4.1.3). For instance, a company may require from a supplier to renounce pesticides, child labor, or under-fair minimum wage payment for his total production, larger than intended for the company itself.
5. Positives to one stakeholder group may not compromise the ability of other (including future-) stakeholder groups to meet their needs (Section 4.1.6).
6. Rebound effects should not be included in LCAs before reliable assessment methods and data are available (Section 4.1.8).
7. No aspect or impact can be a positive that is general to a great number of products or activities, or necessary for maintaining an aspect on a certain level, e.g., employment (Section 4.1.7).
8. A positive is only the demonstrable better part than average. We would even prefer a benchmark of the top 20% performers (Section 4.1.11).
9. A service by a commercial body is only a positive if the activity is not a natural obligation of a government, rich enough to provide it (e.g., provision of infrastructure). We propose to limit positives based on such services to the 20% poorest countries (Section 4.1.7).
10. No positives can be allocated for activities or products that have very negative impact on other aspects than the assessed, unless a process of significant improvements can be demonstrated (not only planned but demonstrably in execution, which actually means that the relevant other aspect is also assessed) (Section 4.1.6).
11. Employment and minimum wages higher than the fair minimum wage can only be considered a positive in the 20% poorest countries and if equally applied for all personnel (Section 4.1.9).
12. Utilities that are beneficial to stakeholders not involved in the economic transaction are positives, but only if also the burdens caused by the product are included in the assessment. An example is an aquifer-depleting fresh water provision installation for a company that also provides free water access to the community (Section 4.1.11). An example of a positive utility for a consumption product is hard to find because of the requirement that they may not be absent of negatives and they are almost always type 1 positive internalities.

Based on these core criteria, we will now list some activities that we propose as positives for the Oiconomy system, but that also may be considered in the EcoCost system and impact-based LCA. The listed activities include aspects mentioned in literature aspects contributing to the Sustainable Development Goals (SDGs) but exclude SDGs that commonly are governmental instead of industry responsibilities. Also excluded are activities that are made by absence of negatives.

5.2 Examples of products and activities fit for positive assessment

Table 2 shows examples of positive and negative internalities and externalities in the three pillars of People, Planet, and Prosperity and how they would be assessed in impact-based LCA and in the Oiconomy system.

Table 2 Examples of positive and negative impacts for internalities and externalities in impact-based LCA and the preventative costs-based Oiconomy system

	Pillars	Type of LCA	Examples		
			People	Planet	Prosperity
Type 2 internalities	Costs (negative)	Impact-based LCA	Noise of a lawn mower	Existing efforts to comply with anti-pollution laws	Profit lost by compliance to anti-corruption rules
		Oiconomy system	Costs to reduce the noise to zero effect level	Expenditures on pollution prevention	Profit lost by compliance to anti-corruption rules
	Benefits (positives)	Impact-based LCA	The social contacts by a job	Long-term capture of CO_2 in wooden buildings	Honey for private use from keeping bees for pollinating
		Oiconomy system	None	Saved costs for CO_2 capture	The prevented costs of buying honey
Externalities	Costs (negative)	Impact-based LCA	Impact of unsafe working conditions	Emitted CO_2	Impact of corruption and of unfair transactions
		Oiconomy system	Costs of a perfect Occupational Health and Safety system	Prevention costs of CO_2 emission	Profit obtained by corruption and unfair transactions
	Benefits (positive)	Impact-based LCA	Tourist resorts given free access to their private beaches	Restoration of an ecosystem	Employment by employee's local expenditures
		Oiconomy system	Tourist resorts given free access to their private beaches	Expenditures on restoration of an ecosystem	Employee's local expenditures minus costs of therefore "imported products"

This table does not include type 1 internalities, as depicted in Table 1. The following examples in the table deserve some discussion: Characterizing long-term CO_2 capture in buildings as a positive type 2 internality assumes that the CO_2 capture was intended, not more expensive than using other materials and the wood sustainably grown. However, if building in wood is more expensive and the argument of CO_2 capture is an argument in the economic transaction, this capture would be a type 1 internality. This shows that in practice, there will always be cases that need careful assessment before characterizing them as positive in LCA. Another example to discuss is the characterization as a positive internality in impact-based LCA of social contacts in a job, while in the Oiconomy system, the quantification is zero, because the social contacts represent no monetized benefit, which shows that the measured effect depends on the type of LCA.

In addition to Table 2, we can give a short list of categories of activities that would be applicable as positives both in the field of environmental LCA (5.2.1) and social LCA (5.2.2).

5.2.1 E-LCA

1. Recycling of old waste (not of current waste, because that would be "absence of negatives" (SDG-11,12)
2. Recovery or restoration previously caused damage (SDG-11,12)
3. R&D, investment, and installation for impact-mitigating products or technology (SDG-6,7,9,13), but only if one or both of the following applies:

   (a) The technology is especially designed for the impact mitigating purpose.
   (b) Best 20% mitigating performance on the aspect in the market can be demonstrated.

The development and investment of sustainable capturing of CO_2 or other GHGs would be a positive. The capturing itself would also be a positive if taken from the atmosphere, but not if used for prevention of industrial emissions, because that would be "mitigation of negatives."

4. Restoration and/or long-term protection of natural ecosystems, or upgrading of soil or water systems (SDG-14, 15), other than damage caused by the actor's own activities
5. Over-average crop yields in agriculture, compared with the yields by country, listed in (FAO 2019) (SDG-15), but only if the agricultural negatives are also included in the assessment
6. Under-normal cost price provided beneficial by-products (e.g., heat from a power or chemical plant, used for municipal heating), sustainably mitigating impacts (SDG-12,13,14,15)

7. Payments for ecosystem services (UNDP 2015) and of environmental taxes

5.2.2 S-LCA

1. Poverty-reducing activities by capacity/ability improving means (e.g., micro-credits) or by other means, or hunger relief in the 20% lowest-income countries (SDG-1, 2)
2. Healthcare (Srinivasan et al. 2003; Ekener-Petersen et al. 2016) (SDG-3), other than for inflicted harm in the supply chain itself
3. Capacity building, e.g., education and training in the community, either intern or extern (excluding "on the job") (Ekener-Petersen et al. 2016) (SDG-4)
4. Helping underdeveloped actors to sustainably raise quality, yields, or sustainability also for others than involved in the relevant supply chain (various SDGs)
5. Reducing gender inequality and empowerment of women and girls outside of the own company (SDG-5)
6. Improving water safety and availability in the 20% lowest-income countries (SDG-6)
7. Employment, but only if all of the following applies:
   (a) The country or region has a (far) below-average employment rate.
   (b) The employment is locally net-positive, which means not at the expense of other local employers.
   (c) The employment is long term, and the involved companies/industry sectors have no history of short-term displacements.
   (d) The involved country has a high corruption perceptions index (low corruption), or the company can demonstrate absence of corruption (reversal of the burden of proof).
   (e) The fair minimum wage (Croes and Vermeulen 2016b) is paid to all employees, and the country has an almost zero child labor percentage or the company can demonstrate zero child labor (reversal of the burden of proof).
   (f) Good Occupational Health and Safety conditions can be demonstrated, e.g., by certification to ISO 45001. (SDG-8)
8. Second-order local employment in the 20% lowest-income countries, caused by the local expenditures of a company's employees
9. Employing of people with distance to the labor market by a mental or physical handicap (SDG-8,10)
10. Donations to recognized and effective sustainability pursuing NGOs, but excluding political entities (SDG-17)
11. Providing beneficial products below cost price, e.g., medicines for the underprivileged (SDG-1)
12. Providing free services, e.g., internet services with positive sustainability impact, but only if the related negative aspects (e.g., invasion of privacy; spam) are also assessed
13. Emergency relief, freely at the disposal of the community (SDG-3,11)
14. Protection of cultural heritage and indigenous peoples and stimulation of cultural activities that do not harm sustainability (SDG-11)
15. Sustainable contributions to the local community (infrastructure in the 20% poorest countries, nature, sponsoring, cleaning, sport (Schulenkorf and Edwards 2012), art, and other cultural aspects (Archer et al. 2005; Belfiore and Bennett 2007) (SDG-11,17).

These examples show that our proposals for core criteria give ample room for positive assessments for R&D, restoration, urban mining, efficient land use, protection of ecosystems and cultural heritage, health care, aid, and various other activities in low-income countries. In our opinion, adhering to the underlying objectives of prescriptive LCA and therefore to a coherent set of criteria for the inclusion of positive impacts enables assessment of positives in LCA without endangering its credibility. Intentionally not discussed in this paper was how to assess and quantify the positives, leaving that to the LCA and S-LCA scientific communities.

6 Conclusions

This study demonstrates several serious ethical and practical issues and challenges to consider before including positive impacts in LCA and especially S-LCA. Based on these, a set of core criteria for inclusion of positives was proposed and examples given of activities and products that could be characterized as positives. Our goal is, next to developing the assessment of positives for the Oiconomy system, to open a discussion on setting criteria for inclusion of positives in LCA in general. We showed that LCA includes both conflicting characters of descriptive and prescriptive science, with the risk that descriptive features seriously hurt the ethical goals of prescriptive LCA as described in ISO 14040. An especially difficult question is how to strictly interpret the economic concepts of externalities and internalities in relation to LCA. The major body of LCAs assesses externalities, but also negative impacts of products' utilities. However, utilities that affect the buyer of the product are in economic terms internalities. We provided multiple reasons why internalities positively affecting the seller-buyer transaction partners and affecting the price should not become part of LCAs. Therefore, we proposed to, for LCA purposes, define positive internalities in two groups: type 1, benefits considered by the transaction partners and type 2, not considered, neglected, or

underestimated by the transaction partners and not affecting the price, which type could be included in LCA. Another important question is how to deal with the regularly mentioned requirement of a capacity-raising impact, indicating that a positive should bring an aspect to a higher level. We showed the importance of this criterion but also some of the difficulties of distinguishing capacity raising from maintaining the current status. On three issues, we are more conclusive: First, in our opinion, employment should not be included as a positive in LCA without a range of additional criteria. Second, especially in S-LCA, there is the danger of comparing the positives for one stakeholder group with the negatives for another stakeholder group, because that easily becomes unethical and against the principles of prescriptive LCA. And third, LCA should not mix measurement by change with measurement by status without extra criteria and rather keep track of a change by repetition of measurement by status. Given the issues found in this study, imprudent inclusion of positives in LCA could easily result in reduction of its discriminate meaning, whitewashing, and loss of its credibility. A possible result of a debate in the LCA community could be to not include positives in LCA at all. Another option is to consistently separate positives out of LCA but assess these in another system, for instance "hand printing," proposed by Norris (2015), but then not use the direct comparison by the proposed formula of [Net positive = Handprint − Footprint] (Benoit Norris et al. 2020). A third option would be to describe in the goal of an LCA if that goal is descriptive or prescriptive, but then also consistently follow the chosen principle. Our preference would be to include positives in LCA and S-LCA but carefully limited to very clear positives, complying with strict criteria, for which we made a first proposal in this paper. This also applies to the Oiconomy system, in which we will implement the criteria obtained from this assessment.

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