Why “Circular” doesn't always mean “Sustainable”

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Perspective

Why "Circular" doesn't always mean "Sustainable"

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In the course of our research at the intersection between academia and practice, we have observed that practitioners often regard the circular economy (CE) as a concept based on one simple rule: The more material is kept in circulation, the better. However, the mere fact that materials are circulated does not necessarily equate to greater sustainability. Nevertheless, practitioners often cite the quest for sustainable development as an argument in favor of a CE. In the following, we address this disconnect, and suggest that all CE activities should be assessed in the light of economic, environmental, and social sustainability.

To build the case, let's look at two examples where simply recirculating more material is not necessarily more sustainable. First, consider additives used in polymers. These are often harmless during the first use of the plastic, but may become harmful if secondary materials are used for a purpose other than the one they are designed for. Therefore, recycling polymers that incorporate hazardous additives might not be environmentally desirable. A second example is making insulation from recycled glass containers, which offers better environmental performance than closing the loop and turning the glass back into bottles (Haupt et al., 2018a). In both cases, increased circularity leads to a worse performance in terms of environmental sustainability. These examples from practice may be well intentioned, but the focus on incremental improvements to CE activities can do more harm than good. To sum up, the circularity of materials *per se* is a means, not an end in itself. If we want CE to deliver its promises, industry and policy practitioners must assess sustainability aspects before implementing CE activities.

The starting point for our proposal is the popular definition of CE proposed by the Ellen MacArthur Foundation: "Looking beyond the current 'take, make and dispose' extractive industrial model, the circular economy is restorative and regenerative by design. Relying on system-wide innovation, it aims to redefine products and services to design waste out, while minimizing negative impacts. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural and social capital" (Ellen MacArthur Foundation, 2018).

According to this definition, CE promises to protect the planet while ensuring economic prosperity. However, the definition also underplays sustainability aspects, which are therefore neglected in practical implementation activities. To remedy this, we suggest a new term: *sustainable circular economy* (SCE). We argue that economic, environmental, and social aspects need to be more carefully considered in the transition towards a CE, in addition to the conceptual criterion of material circularity. Only when we account for sustainability aspects can we ensure a transition towards an SCE. Our guiding light should not be to build as many circular product systems as we can, but rather to ensure economic sustainability and a healthy planet while contributing to sustainable development goals(SDG Society, 2019). The following four dimensions are relevant:

- Material circularity (MC) is developing positively if more material is circulated at its highest possible quality. MC can happen in different ways, e.g. by reuse, refurbishment, remanufacture, or recycling. There is a range of tools and indicators to measure MC; a popular one is Material Flow Analysis.

While material circularity refers only to the investigated life cycle stage of the product or service under study, the sustainability performance is assessed using a life cycle perspective:

- Economic Sustainability (EconSus) is developing positivelyif economic value is generated. In including this dimension, weadhere to the neoclassical growth paradigm, as this is currently also the

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backbone of most CE concepts.There are only few tools available that link CE and value creation. For practical reasons,EconSusassessment is often conducted at the level of the firm, for which Life Cycle Costing is a possible tool.
- Environmental Sustainability (EnvSus) is developing positively if less harm is done to the environment, e.g. if the impact on climate change is reduced, or if the natural habitat for animals is better protected. As EnvSus has several different aspects, there are also manifold tools and indicators to measure it. Life Cycle Assessment is one commonly used tool for assessing life cycle environmental impacts of product systems.
- Social Sustainability (SocSus) is developing positively if better social conditions are created for all humans, e.g. fewer working poor, better health services, or less child labor. Measuring SocSus is tricky, as it must also address questions such as «What constitutes a healthy life?» However, there have been some initial attempts at building tools and indicators for SocSus, one such being the Social Life Cycle Assessment.

We further suggest that an activity only contributes to an SCE in its strictest sense if there is positive development in all four of the dimensions. For illustrative purposes, however, we present three of them as dimensions of a cuboid, allowing us to define what we label "the SCE space" (Fig. 1).

Fig. 1(a) shows the circularity space above the zero base plane, within which all activities are circular. In Fig. 1(b), the space on the right-hand side is where all activities are sustainable, although not all are circular. It is labeled as the sustainability space. One could argue that for a sustainable development, this is the only space of importance. However, due to planetary boundaries and the ongoing discussion around the evaluation of resource availability in LCA (Sonderegger et al., 2020), we argue that circularity is important in order to avoid material shortages. Finally, the overlapping volume of the circularity and sustainability spaces constitutes the SCE space (Fig. 1(c)). This is the zone of the cuboid where all three (or, for completeness, four) dimensions exhibit positive development.

A word of caution: Implementing any new solution will almost certainly involve trade-offs among the four dimensions. Such trade-offs will arise if a step forward in one dimension is associated with a step backwards in another. For example, the recovery of 100% of the PET, a plastic material used for soft drink bottles, among others, used in Swiss households would increase MC and EnvSus (Haupt et al., 2018b), but cost more than the additional income generated from recycled PET (which could—depending on the indicator used—represent a negative development of EconSus). An additional element of complexity is that such trade-offs might only manifest over a longer period. For example, the question of whether a product will only reach 90% material circularity after10 years, or within just two, is crucial—especially if the transition is associated with economic costs or negative environmental impacts in the meantime.

What are the lessons for practitioners? For new circular products and services, as well as for CE policies, we suggest assessing the four dimensions of an SCE instead of rushing into quick and simple solutions. Carrying out such an assessment will require time and money. Ideally, academia will develop an indicator system that accounts for all four SCE dimensions, in close collaboration with practitioners. Such a

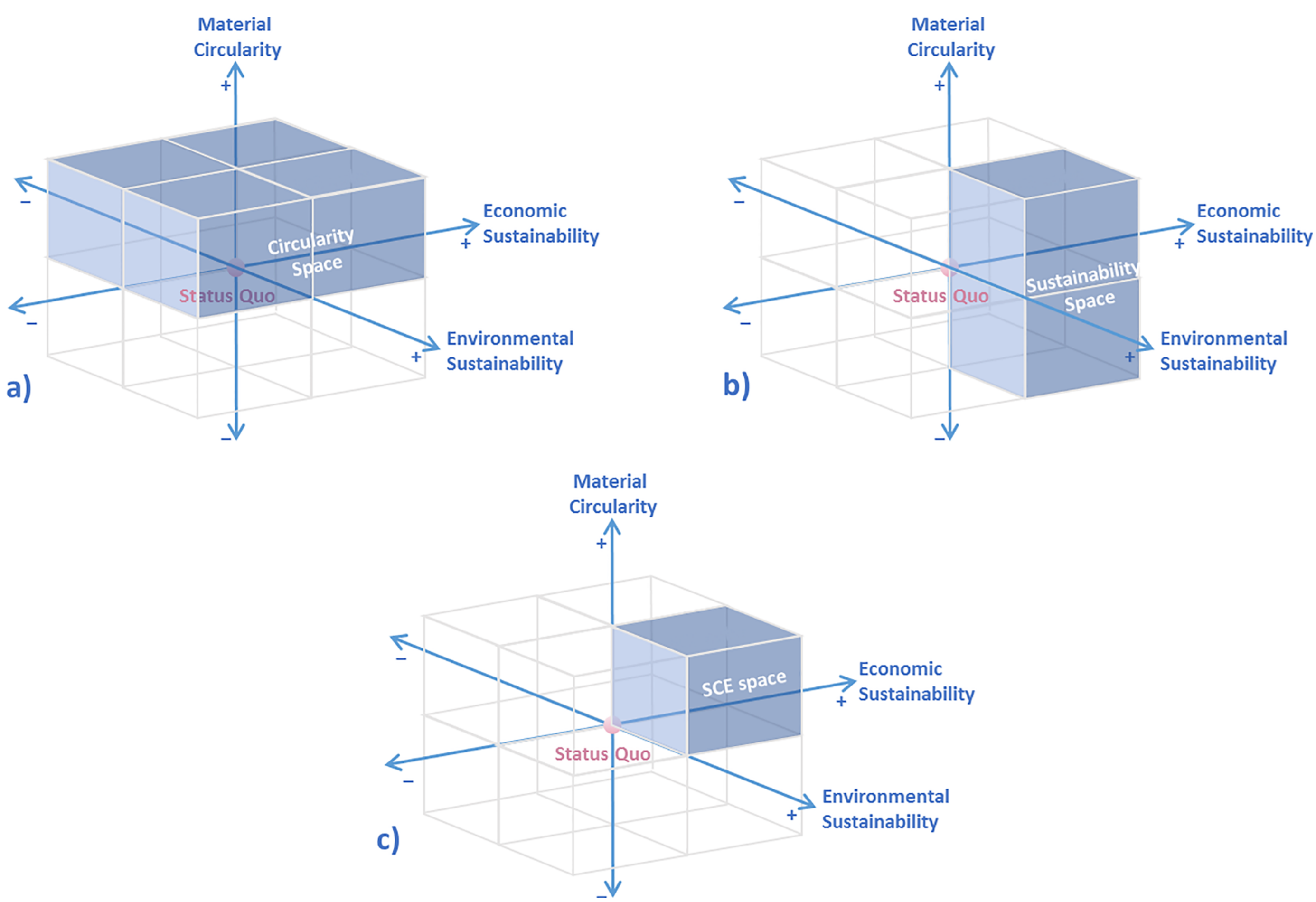

Fig. 1. Defining the SCE space (c) by overlapping the circularity (a) and sustainability (b) spaces in a three-dimensional Euclidian space. For illustrative purposes, we chose to show only material circularity, economic sustainability, and environmental sustainability. Incorporating social sustainability as well would lead to the ideal solution space for SCE.

holistic assessment will allow a data-driven discussion of trade-offs, supporting informed decisions on what CE activities should be favored in order to contribute to sustainable development.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests.

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