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PRESPECTIVE

Circular Economy Flow:er – A Visualisation Rooted in Interrelatedness, Consumer Inclusion, and Co-creation

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Abstract

The transformation towards a circular economy (CE) depends on the active participation and collaboration of actors across different stakeholder groups. Consumers, not least, have a crucial role to play in this shift, yet their perspective has largely been overlooked. This gap is also reflected in existing CE visualisations, which are primarily designed from a company perspective. To encourage more effective involvement of consumers as key stakeholders in the CE loop, this paper proposes a new CE visualisation. The CE Flow:er builds on recent scholarly insights, and seeks to envision CE in a way that is not only relevant from a company perspective, but also inclusive and intuitive for consumers. This flower-shaped visual metaphor also aims to evoke a sense of holism and purpose by illustrating how our inherent interrelatedness with nature calls for regenerative acts in return for the resources we receive.

Keywords Circular Economy · Circular Transition · Consumer · Visualisation · Collaboration · Co-creation · Innovation

"Natural systems take from their environment, but they also give something back. The cherry tree drops its blossoms and leaves while it cycles water and makes oxygen; the ant community redistributes the nutrients throughout the soil. We can follow their cue to create a more inspiring engagement – a partnership – with nature. We can build factories whose products and by-products nourish the ecosystem with biodegradable material and recirculate technical materials instead of dumping, burning, or burying them."

– McDonough & Braungart (2002, pp. 155-156)

1. Introduction

There is an increasing interest and use of the circular economy (CE) concept among both scholars and practitioners (Kirchherr et al., 2023). Among consumers, however, the awareness of and interest in CE remain low (Gonella et al., 2024; Sijtsema et al., 2020). This is problematic because consumers have a crucial role to play in the shift towards a CE (Planing, 2015). There is therefore a pressing need to re-educate and involve consumers in a new way of consumption aligned with CE principles (Vidal-Ayuso et al., 2023). Knowledge visualisations are generally powerful tools for educational purposes, helping to raise awareness and transfer complex knowledge in accessible and engaging ways (Eppler & Burkhard, 2004). However, since the

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consumer perspective has largely been neglected in the CE field (Ertz et al., 2019), this is also reflected in existing CE visualisations.

With a background in consumer-oriented innovation, I share in this paper the perspective that there is a need for a CE visualisation that meaningfully addresses and includes the consumer as a key stakeholder in the CE loop. Consequently, I propose a holistic CE visualisation that aims to be of relevance from all stakeholders' perspectives – including consumers.

2. A Circular Economy Requires Consumer Involvement

The need for increased consumer involvement in the CE context becomes evident when considering current implementation levels: global circularity is as low as 7.2% (Circle Economy, 2024), and consumers represent one of the main barriers to this implementation (Camacho-Otero et al., 2018). Consumer awareness, acceptance, engagement, and collaboration are all required to enable circular flows of resources and value creation (Kirchherr et al., 2023; Tabas et al., 2024; Vieira et al., 2024).

The CE requires new, more active roles from consumers (Sijtsema et al., 2020) and their involvement is essential throughout the whole process (Vidal-Ayuso et al., 2023). Consumers need both to be willing to accept CE solutions and to contribute to the recirculation of resources (Hankammer et al., 2019). Post-purchase activities like sharing, repair, and recycling are dependent on consumer involvement (Vidal-Ayuso et al., 2023). Furthermore, services will have a profound role in the CE transition, which makes reciprocal company-consumer relationships and value co-creation central for supporting circularity (Antikainen et al., 2018; Re et al., 2021; Tukker, 2004; Vargo & Lusch, 2004). This calls for collaboration and co-creation between companies and consumers, starting from the early innovation phases of creating CE solutions based on consumer insights, and continuing through consumer experiences during use and disposal (Re et al., 2021; Tabas et al., 2024).

However, the consumer perspective has received limited attention in previous research and practice (e.g., Ertz et al., 2019; Sijtsema et al., 2020; Vidal-Ayuso et al., 2023). Considerable knowledge gaps exist, for example regarding consumers' willingness to participate in CE solutions (Tabas et al., 2024) as well as the consumer experience (Ta et al., 2022) and value of such solutions (Aarikka-Stenroos et al., 2021). This exclusion of the consumer perspective implies a risk of developing unviable business models due to a lack of consumer demand (Kirchherr et al., 2017).

Another issue related to the neglect of the consumer perspective is the generally low consumer awareness of CE (e.g., Sijtsema et al., 2020), which constitutes a major barrier to its implementation (Vieira et al., 2024). The most profound way to promote the CE transition is through education (Tiippana-Usvasalo et al., 2023), and Bocken (2024) argues that CE must be integrated into education across all levels. Tiippana-Usvasalo et al. (2023) similarly emphasise that the goal should be to turn everyone into a CE expert. There is a pressing need to improve consumers' understanding of the CE concept and its practical relevance in everyday life (Gonella et al., 2024; Sijtsema et al., 2020). Furthermore, consumers need to become aware of the value that CE solutions can provide to them (Vidal-Ayuso et al., 2023). Gonella et al. (2024) emphasise the need for emotionally engaging education that can foster not only awareness, but also action.

Fortunately, the interest in the consumer perspective is on the rise (Vidal-Ayuso et al., 2023) and the need to integrate consumers in CE innovation and loops is recognised by scholars (e.g., Ertz et al., 2019; van Dam et al., 2021). Nevertheless, this emerging topic has a long way to go (Vidal-Ayuso et al., 2023).

3. Three Separations Reflected in Circular Economy Visualisations

Existing CE visualisations (e.g., Bocken et al., 2021; Ellen MacArthur Foundation, 2019; European Parliament, 2023; Geissdoerfer et al., 2020) provide fundamental guidance for how companies can support a CE. They do, however, tend to overlook the consumer perspective. This section discusses how CE

visualisations largely exclude the consumer perspective alongside three identified separations (Figure 1) that all inhibit the transformation towards a CE.

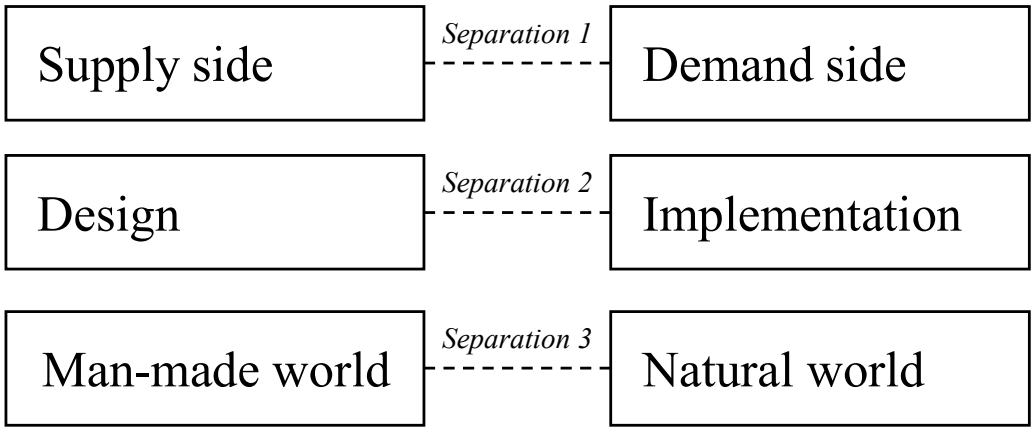

Figure 1. Three separations.

3.1. Separation 1: Supply Side – Demand Side

The first separation lies between the supply and demand sides of CE. Research has often focused on either the supply side or the demand side in isolation (e.g., Tabas et al., 2024). This is exemplified by the tendency to treat upstream approaches (e.g., product design, production, and distribution) separately from consumer-facing downstream approaches (e.g., value propositions, consumer interfaces, and consumption) (Almelhem et al., 2025; Urbinati et al., 2017). However, it is not enough to create offerings based on circular principles – they must also be adopted and valued by consumers (Aarikka-Stenroos et al., 2021). In the context of the linear economy, the consumer perspective has long received significant attention, with increasing focus on the consumer experience (Lemon & Verhoef, 2016; Ta et al., 2022). Creating compelling consumer experiences represents a source of competitive advantage (Kranzbühler et al., 2018) and has become a top priority for companies, with products and services serving as means to that end (Lemon & Verhoef, 2016). This reflects a focus on continuous, iterative interaction between the company and consumer (Schallehn et al., 2019). However, this perspective has received little attention in the context of CE (Ta et al., 2022), which is problematic given that circular solutions ultimately need to compete with linear alternatives.

Researchers suggest that combinations of upstream and downstream approaches into fully circular strategies are the most impactful (Pieroni et al., 2019). Still, previous research has largely neglected the demand-side (Kirchherr et al., 2017) and has instead mainly focused on managerial and supply-side perspectives (Aarikka-Stenroos et al., 2021; Ertz et al., 2019). But the transition towards a CE requires collaborative efforts that engage stakeholders across the supply and demand sides (Tabas et al., 2024). There is thus a need for a more integrated and holistic approach (Almelhem et al., 2025; Pieroni et al., 2020).

However, existing visualisations reinforce this separation by being relevant primarily from the supply side, as they illustrate circular principles in relation to company processes. The EMF butterfly diagram (Ellen MacArthur Foundation, 2019) has previously been criticised for neglecting the critical role of consumers (Skene & Oarga-Mulec, 2024). Similarly, the visualisations by Bocken et al. (2021), the European Parliament (2023), and Geissdoerfer et al. (2020) are framed from a supply side perspective. As a result, the implied value conveyed by these visualisations is primarily appealing from a company viewpoint (e.g., efficiency-related gains), while they are less suited to intuitively educating and engaging consumers in circular principles relevant to their everyday lives.

3.2. Separation 2: Design - Implementation

The second separation is the gap between design and implementation, which inhibits the CE transformation since new CE solutions (e.g., business models) often fail to enter or succeed in the market (Baldassarre et al., 2020; Brown et al., 2021a). A lack of consumer acceptance represents one of the main barriers to the implementation of CE solutions (Camacho-Otero et al., 2018). Solutions must be developed based on consumer insights so that they solve unmet consumer needs and problems in order to attain successful implementation (Hankammer et al., 2019). However, most companies focus on improving their processes and energy use, rather than considering or involving consumers in their innovation processes (Vidal-Ayuso et al., 2023). This reflects the predominant focus on upstream activities (e.g., design and production), where many ideas and solutions are developed without sufficient emphasis on the downstream needs and implementation. Pieroni et al. (2019) note that innovation approaches for creating circular business models tend to focus solely on single stages rather than a holistic and continuous process, thereby contributing to the design-implementation gap.

Research suggests that iterative and consumer-oriented innovation approaches can help bridge the design-implementation gap (e.g., Brown et al., 2021a; Hankammer et al., 2019) and methods that incorporate collaboration, experimentation, and co-creation with consumers can support insight-based development of desirable solutions (Baldassarre et al., 2020; Brown et al., 2021a; van Dam et al., 2021). By involving consumers in the innovation process, companies can gain a better understanding of their needs and opinions – which should guide the design of products and services (Vidal-Ayuso et al., 2023). Baldassarre et al. (2020) found that early and iterative implementation of sustainable business model ideas, through prototyping, can help bridge the design-implementation gap by ensuring development of solutions that are desirable to consumers. Upstream and downstream actors thus need to be connected, to co-create solutions based on a shared vision (Brown et al., 2021b).

While visualisation tools can support such an approach to innovation (e.g., Brown et al., 2021a), existing CE visualisations tend not to encourage a consumer-oriented and collaborative approach. Instead, CE visualisations convey more or less sequential, stepwise processes rather than iterative and continuous approaches. For instance, the consumer activities of ‘Use’ (Ellen MacArthur Foundation, 2019; Geissdoerfer et al., 2020) respectively ‘Consumption’ (Ellen MacArthur Foundation, 2019; European Parliament, 2023) are visualised as subsequent phases to design and production. In this way, such visualisations risk reinforcing – rather than challenging and bridging – the problematic divide between design and implementation.

3.3. Separation 3: Man-made World – Natural World

The third separation lies in the disconnection between our world of man-made systems, objects, and materials, and our natural world. Throughout our history, humans have spent nearly all of their time in nature (Miyazaki, 2021). However, alongside industrialisation, urbanisation, and digitalisation, we have become increasingly separated from nature. This separation is a key driver of the environmental decline (Curll et al., 2025). There are several dimensions and underlying causes of this disconnection, such as modern urban lifestyles and worldviews that reduce both direct experiences of nature and the sense of being part of it (Beery et al., 2023). The overall societal shift towards viewing nature as a resource for our own progress might further contribute to this disconnection (Curll et al., 2025).

From an organisational perspective, sustainability literature suggests that organisations should recognise nature as a stakeholder in order to promote operations that not only avoid damage, but ultimately benefit nature (Stubbs & Cocklin, 2008). Already in 2002, McDonough and Braungart argued in their influential book ‘Cradle to Cradle’ that a focus on being less bad (eco-efficiency) is not enough in the long term. Instead, they advocated for a vision of being 100% good, where waste is viewed as food and a way of giving back to nature (eco-effectiveness). Similarly, CE researchers like Niessen et al. (2024) promote the need for a CE that integrates radical approaches of sufficiency (making do with less (Bocken et al., 2022)), regeneration, and flourishing (allowing for all life on Earth to flourish forever (Ehrenfeld & Hoffman, 2013)). However, business

actions are still mostly focused on efficiency and incremental solutions, which is insufficient for the required transformation (Niessen et al., 2024).

Care is an essential trait of a CE (Stahel, 2019), and consumers' connectedness with nature is linked to pro-environmental attitudes and behaviours (Curll et al., 2025). One way to foster a sense of such connectedness is through education and learning about our interconnectedness with nature (Ives et al., 2018). Existing CE visualisations (European Parliament, 2023; Geissdoerfer et al., 2020) do, however, rather reflect a disconnection between the man-made and natural world. Through their mere focus on decreasing negative damage, they miss out on suggesting any explicit enhancing influence on nature in return. The visualisations do so by promoting efforts to minimise the input of resources, and leakage of bad outcomes (waste and emissions). Bocken et al. (2021) take it one step further by visualising regeneration as a positive part of the process instead of displaying negative outlets from the loop. However, none of the visualisations illustrate a sense of human-nature connectedness.

4. Circular Economy Flow:er

To ensure that academic knowledge is useful, it must be compatible with the reasoning process of the receivers (Worren et al., 2002). Visual metaphors are a type of knowledge visualisation that is supportive in conveying complex insights by helping the receiver to relate the expert knowledge to what they already understand (Eppler, 2003). The CE Flow:er (Figure 2) is a conceptually derived visual metaphor that uses a natural object to represent a CE conceptualisation in a meaningful way. Such visual metaphors generally not only facilitate understanding and remembering, but also encourage interactive participation (Eppler, 2003).

The CE Flow:er builds upon the recent and extensive CE conceptualisation by Kirchherr et al. (2023) by including Reduce, Reuse, and Recycle, while expanding the fourth R of the framework (i.e., Recovery) with the broader term Return. Thereby, the fourth petal of the Flow:er (Return) encompasses the return of resources in a dual sense by integrating both recovery and regeneration.

First, it covers the return of recovered materials and energy into new production cycles (see arrow 1 in Figure 2a), including activities such as urban mining (Shahabuddin et al., 2023), anaerobic digestion (Ellen MacArthur Foundation, 2013), or energy recovery through incineration (Henry et al., 2020). In contrast to the first three Rs, Recovery may therefore appear less instructive for consumers, as they are generally not actively involved in these activities. The term Return, however, is intended to align more closely with everyday consumer terminology and activities, to make it more applicable and action-inspiring.

Secondly, while Recovery can be regarded as a last resort (typically through incineration), Return aims to illustrate a fully closed loop that includes nature as a stakeholder. The descending arrow with a falling, withering petal (see arrow 2 in Figure 2a) highlights the acknowledged importance of giving back to nature in ways that support the regeneration of natural ecosystems (Bocken et al., 2021). Regenerative attributes of CE have long been encouraged (Ellen MacArthur Foundation, 2013), and Henry et al. (2020) argue that the 4R framework should be expanded to include Regenerate as a fifth R. Regeneration implies a focus on co-creating products and services that improve the wellbeing of both people and the natural environment (Konietzko et al., 2023). Examples include urban agriculture, green roofs (Henry et al., 2020), composting (Ellen MacArthur Foundation, 2013), supporting reforestation projects, and product designs based on non-toxic, biodegradable materials (Konietzko et al., 2023). In this sense, Return extends the meaning of the fourth R, aiming to stimulate nonlinear thinking by replacing targets of 'minimised leakage' with positive, regenerative actions.

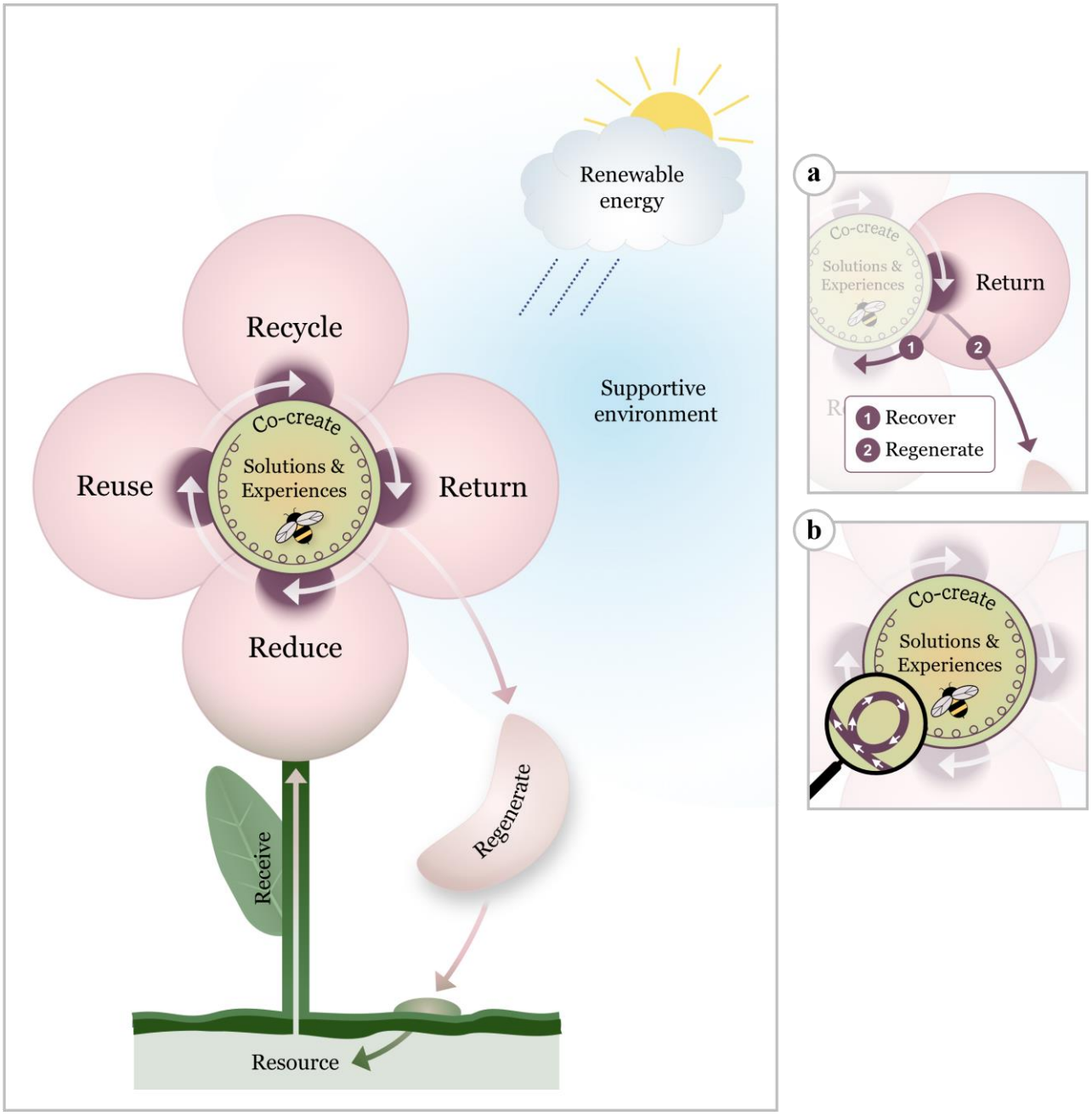

Figure 2. Circular economy Flow:er.

The Flow:er further aims to convey a sense of purpose. It does so by drawing inspiration from nature, which has operated according to circular principles throughout the history of Earth (Stahel, 2019). All species on Earth have a function, with duties to provide as well as gifts to receive (Kimmerer, 2013). By emphasising responsible receiving and returning of resources, it serves as a visual reminder of our inherent interrelatedness with nature. Just like the flowers, we too can – and should – play a positive role in supporting our natural environment. This can however not be done by any actor in isolation. At the centre of an actual flower is where reproduction takes place, and – as symbolised by the bee and the surrounding iterative loops (Figure 2b) – this element of the Flow:er represents the need for continuous collaboration. Consumers, companies, and nature need to form mutually beneficial relationships to bridge the separations. The central notion of 'Co-create Solutions & Experiences' highlights the importance of developing circular solutions (e.g., business models,

products, and services) that are paired with experiences designed to engage consumers. Its circular shape further underscores the need for iterative, ongoing efforts to co-create value through solutions and experiences that enable circular flow of resources.

5. Final Remarks

The Flow:er is an attempt to translate recent CE research advancements into an accessible knowledge visualisation of relevance and value not only for companies, but also for consumers. By using a visual metaphor from nature in the shape of a flower, it intends to break away from linear thinking patterns and instead inject a sense of understanding and humility that we are part of nature. A bold, even idealistic vision, some may challenge. But if a CE visualisation does not dare to be radical, how can it be expected to inspire changes that are?

The Flow:er was created to convey a high-level CE visualisation, general enough to have the potential to serve as a shared vision for inspiring positive action across various stakeholder groups. This is similar to the intention behind the iconic SDGs, which were designed to foster universal understanding and inspiration for everyone (The New Division, 2015), while their specific descriptions and implications are adapted depending on the audience. In the same way, the Flow:er aims to provide a common point of reference, conveying information relevant to all actors – including consumers, which differentiates it from existing CE visualisations. To function as such a shared vision, the visualisation should be used in its entirety but complemented by more detailed descriptions tailored to specific purposes and audiences. For example, while all actors need to engage in reuse, their contributions vary across stakeholder groups such as governments (e.g., legislation and infrastructure), companies (e.g., designing durable products and offering them as services), and consumers (e.g., choosing second-hand options or product leasing).

Future research is needed to empirically investigate the usefulness of the CE Flow:er, particularly when further specified and applied to different contexts and stakeholder groups. As examples of potential practical applications, this visualisation could serve as an educational tool to increase consumers' awareness of the CE concept. Moreover, it could be used as an educational resource for practitioners, to increase the understanding of CE principles and the importance of a consumer-oriented view. This neutral visualisation could also support transparency and decision-making regarding responsibilities, product and material flows, and other relevant aspects, and may encourage stakeholder groups to reflect on their roles in relation to others. For innovation purposes, it should be accompanied by suitable innovation approaches, such as design thinking tools, to facilitate the co-creation of new CE solutions and experiences.

The implications of the Flow:er may seem radical when viewed from the perspective of the man-made, linear world. Yet from the viewpoint of the natural world, it simply points to a way of working that is inherent to our very nature. If all other living species manage to co-create value in collaboration with nature, then could we not also?

"All flourishing is mutual"

– Kimmerer (2024, p. 33)

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