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Expert and Diffuse Design of a Sustainable Circular Economy in Two German Circular Roadmap Projects

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Abstract: According to sustainability transitions theory, socio-technical change requires a convergence of politics, social change, technology, and niche innovations. Recently, a circular economy has been proposed as the engine of such change in the EU New Green Deal and Germany. Mainstream circular economy emphasizes the closing of material loops as the way to ensure green growth, and there is a key role for design to achieve such change. According to reports, however, the global appetite for a circular economy remains limited and critics have pointed to several contradictions between the rhetoric and reality of the circular economy and sustainable development. In addition, current formulations of circular economy misrepresent the plurality of discourses for a sustainable circular economy and the role of expert and diffuse circular design. In this study, we employ the recently articulated ten principles for a sustainable circular economy and society to analyze two contrasting circular roadmap projects in Germany, which reflect two contrasting technical and reformist circular discourses, and understandings of the role of design. We find that there are narrow and broad interpretations of design inherent in these circular policies as well as the exemplification of the difference between a technical circular economy and reformist circular society discourses. The practical applied value of this analysis is that the framework can be employed to analyze other policies.

Keywords: sustainable circular economy; sustainable design; circular design



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1. Introduction

Considering the dramatic ecological changes associated with climate change and their effects, shifts away from fossil fuels as energy sources and respect for development within safe ecological limits (Meadows et al. 2004) and thresholds are necessary (Rockström and Steffen 2009). Sustainable development finds its most current formulation in the 17 UN SDGs, which identify the global agenda for the period 2015–2030. The SDG goals, targets, and actions formulate the processes by which sustainability as an outcome might be achieved, including through decoupling resource use and emissions from growth (Fisher 2020). As critics note, however, unless a multi-solving logic that identifies the interactions among social, environmental, and economic goals is adopted, the policy is likely to be fragmented and unsuccessful (Nilsson et al. 2016).

Two key aspects for an integrated SDG vision are a strong sustainability paradigm (e.g., Neumayer 2003) and a theory of change. Given the dramatic nature of ecological changes and rising emissions, a mainstream approach is no longer a viable discourse for sustainability transitions. Mainstream sustainable development is based on ecological modernization where technological innovation, green growth, and voluntary regulation are drivers of change (Fudge and Rowe 2001). In contrast, strong sustainable development is an agenda of reform (Gibbs et al. 1998), which resists sacrifices of natural capital in exchange for technical and human capital and envisages stronger regulation and policy, including towards a more inclusive and just transition. Baker's Ladder of Sustainable Development

(Baker 2013) spells out the multi-dimensional implications of the continuum of discourses or paradigms, including strong and weak sustainability. For a descriptive theory of change, we suggest sustainability transitions theory, and for a prescriptive strategy, the ten principles for a sustainable circular economy.

2. Multi-Level Sustainability Transition(s)

Among the changes required for a sustainability transition is a new socio-technical regime for production and consumption. Sustainability transitions theory offers a vision of the multi-level ecological, institutional, and technical drivers which promote such change. The theory is focused on the emergence of a new socio-technical configuration in an industry-economy context of broader political, cultural, and economic dimensions.

While Loorbach et al. (2017) suggest that socio-technical, socio-ecological, and socio-institutional perspectives differentiate the field, these appear to us to be all elements of the multi-level perspective, which can be fore- or backgrounded. Thus, for the socio-technical transformation of production and consumption processes identified in SDG 12, the multi-level sustainability transitions theory is a “mid-level theory” (Geels 2011), which assumes but does not directly address the social, institutional, and political changes for a new configuration of production and consumption processes. Transitions theory has strong support from the EU as a guide to the promotion of sustainability through government policy and other mechanisms (European Environmental Agency (EEA) (2019)).

As Geels (2011) has shown, socio-technical regime changes depend on bottom-up, niche innovations in protected spaces, and top-down initiatives in policy, science, and socio-cultural changes in the context of changing “landscape” conditions and pressures. These changing landscape conditions are the broader dimensions of sustainable development, as identified in strong and weak paradigms (Baker 2013). The COVID-19 pandemic, war in the Ukraine, and climate change exacerbated events are examples of landscape-level disruptions driving changes, including new energy and supply chain debates and changes. A new socio-technical regime emerges because landscape changes and disruptions destabilize the status quo. At the micro-level, niche innovations visualize new business—society—environment constellations, e.g., the sharing economy and possibilities. Niche innovations, hitherto marginal, align and scale with these changes to become part of a new regime (Augenstein et al. 2020; Hargreaves et al. 2013; Smith 2004).

Transitions theory, however, tends to represent socio-technical change as a change from a current to a new regime. However, it is important that socio-technical regime change is not viewed from the perspective of a single discourse (Genus 2014). In fact, as Paredis (2011) notes, there are multiple possible sustainability transitions, which are underpinned by different scenarios of what this can look like (see Olson 1995). For example, a transition of social solidarity, appropriate technology and ecological limits will look very different as a socio-technical regime change to a regime where markets for green growth under technical optimism take center stage. The danger, thus, is in seeing socio-technical regime change as singular and not plural in the relevant sense since transition visions depend on the details of the new economy in contrast to business-as-usual neo-liberal growth (Longhurst et al. 2016). This plurality becomes important when assessing the principles and goals of competing circular narratives, policies, and politics (Leipold et al. 2021).

Typical government–industry reactions to circular change are new policies, standards, and norms for the socio-technical realm; these include multi-stakeholder Roadmap projects, such as those discussed in this paper. Thus, sustainability transitions theory provides a vision of the strategic policy oriented (planned) and contextual (unplanned) changes, which encourage a shift towards a new industrial–economic environment. This shift will look different depending on the sustainability narrative or discourse underpinning it. We show in what follows that the mainstream circular economy narrative is only one of several narratives, including a role for socio-technical regime change. We also note that it is a modest incremental change to the status quo, has been hitherto relatively unsuccessful

in implementation, and requires a significantly expanded agenda to achieve inclusive development for the future.

3. Circular Economy as Engine of Socio-Technical Regime Change?

The circular economy model has been strongly promoted in Europe, China, and other regions as the answer to green growth and transformation to a new socio-technical regime (Domenech and Bahn-Walkowiak 2019; Mathews and Tan 2016). It is a model, which promises a more sustainable production and consumption system or performance economy (Stahel 2020). The EU sees the circular economy as a key mechanism in all sectors for the EU Green Deal and climate neutrality by 2050 (Rofifah 2020). Albeit in a more limited interpretation as a recycling and waste management narrative—it has a history in Germany stretching back to the mid-1990s (Rudolph 2018). Current critics suggest progress towards transformed business models and industry change has been limited so far, and this limited national uptake has led to the creation of recycling but not a circular economy (Wilts and Fink 2016; Ogunmakinde 2019).

The circular economy is a familiar narrative of ecological modernization (Christoff 1996), which depends on industrial symbiosis and eco-industrial parks for full implementation (Saavedra et al. 2018). In its popular form, as adopted by governments and other actors, it promises business opportunity and industrial production and consumption decoupled from resource use and waste (Ellen MacArthur Foundation 2013). Stahel (2010) links this notion with a dematerialized economy with no waste streams—recycling being excluded—and focuses on meeting human needs in an economically feasible way, including through carbon taxation and other resource redistribution tactics. In this way, a factor 10 reduction in consumption and GHG emissions will be achieved.

However, the latest independent reports suggest, the approach has had poor global uptake of less than 9% (Platform for Accelerating the Circular Economy (PACE) (2020)). Criticisms of the concept as an umbrella term (Homrich et al. 2018) point to its origins in a variety of scientific, e.g., industrial ecology, and semi-scientific concepts and as a depoliticization of key socio-economic factors of sustainable growth (Corvellec et al. 2021). Basic assumptions concerning the values, societal structures, cultures, underlying worldviews, and the paradigmatic potential of CE also remain largely unexplored (Korhonen et al. 2018). Critics have also identified theoretical and practical weaknesses in the mainstream proposals, including the rebound effect of increased consumption (e.g., Makov and Vivanco 2018), and a disconnect from sustainable development (Garcia-Muiña et al. 2019).

Although protagonists see the spread and popularisation of the model as the goal, i.e., circularity for circularity's sake (Harris et al. 2021)—any assessment of its value must be measured by its contribution to sustainable development (Blum et al. 2020). With reference to the SDGs, the aim of sustainable consumption and production (SDG12) is of relevance to the approach. Several other goals, e.g., SDG 7 Affordable and Clean Energy, identify elements that can also play a role, especially in the socio-technical realm of the economy (Ghosh 2020). However, if circular economy is to contribute to these goals several theoretical, semantic, and practical weaknesses, as identified above in the current formulation need repairing (Millar et al. 2019).

Given its limited global uptake and the relatively conservative nature of the changes (e.g., increased recycling rates, product longevity), the mainstream circular economy could be seen as a transition “adjustment” rather than a socio-technical regime change. The circular economy assumes a mainstream neo-liberal economy and does not address how markets, society, government, and the environment need new forms of interaction (Stegeman 2015). Thus it “lacks an economic theory that can pragmatically guide the transition from the prevailing neoclassical model towards one that would drive the transition towards a sustainable circular economy and be palatable for governments” (Velenturf and Purnell 2021, p. 1453).

4. Sustainable Circular Economy and Society: Contrasting Approaches

The articulation of a sustainable circular economy specifies the elements of this theory of transition and recognizes the fact that there are competing circular discourses in many countries (e.g., Melles 2021). Thus, Calisto Friant et al. (2020) develop a typology of four broad circularity visions relevant to sustainable development. In their framework, the circular economy is described as a relatively conservative technology-centric circular discourse (Calisto Friant et al. 2020) and compared to other more reformist and transformational circular society proposals, e.g., Doughnut Economics (Raworth 2017). The nature of the niche innovations and higher-level regime changes in business, industry, policy, etc., are consistent with this non-disruptive socio-technical “imaginery” (Kovacic et al. 2019).

Most relevant to this discussion is the contrast of the mainstream “technicist” with the reformist circular economy, including with reference to design. Both narratives see a role for capitalism, markets, and growth, albeit under degrees of revision consistent with the widely circulated contrast of weak and strong sustainability around growth limits and conservation of natural capital (Melles et al. 2015). Calisto Friant et al. (2020) cite Doughnut Economics (Raworth 2017) as an example of a reformist agenda, although a close reading of Raworth suggests this model has elements of a skeptical approach to capitalism. In comparison to the mainstream circular economy model, the reformist circular society model adds considerations of participation and equitable resource distribution (Jaeger-Erben et al. 2021). For this paper, the technicist circular economy and the reformist circular society discourses underpin two circular roadmap projects in Germany, which we analyze below.

The combination of a circular economy and circular society model is consistent with what elsewhere is described as a sustainable circular economy (Velenturf et al. 2019). The society model places emphasis on participatory and co-design approaches to the social innovation required to promote system change (see Britton 2017). It is a narrative that continues to see a role for growth and markets but not without social and political reform of an economy operating within ecological boundaries (as in Raworth 2017). From the perspective of design, circular economy, and society embrace, respectively, include expert, e.g., industrial design, and diffuse design methods for social innovation (Manzini 2015). We describe this contrast in more detail in what follows.

5. Expert and Diffuse Design for Circular Economy and Society

The role of design has been increasingly highlighted as a “catalyst” (Moreno et al. 2016) for the circular economy. Andrews (2015) notes:

“Designers must now respond to very different social, economic and environmental needs and adopt a holistic approach to problem solving; they must change their design thinking and practice and lead the development of the Circular Economy by creating products and services that match all inherent criteria of this model”. (Andrews 2015, p. 313)

The importance of design for sustainability is a discussion with a long history that predates recent circular economy and design discussions. Manzini (2015) provides a helpful distinction between the traditional product-related design focus, which still defines industrial design, and the broader non-design-focused applications of design into policy (e.g., Howlett 2020), where, in the context of social innovation they distinguish expert and diffuse design—hybrids of expert design in diffuse design contexts are also possible. Hence, in this paper and unlike other discussions of new competencies for circular design (e.g., Sumter et al. 2020), we take expert design as only one of the disciplinary contributions of design to sustainable change.

An early critique of the unsustainability of expert industrial design was the work of Viktor Papanek—*Design for the Real World* (Papanek 1971), which gave rise to the development of social design (Melles et al. 2011). The expansion of industrial design and other design fields into co-design and co-creation service and other spaces, e.g., policy, outside of expert design per se (Sanders and Stappers 2008), has meant that the question

of design's contribution to sustainable development has become more complex (Ceschin and Gaziulusoy 2016). Thus, the contribution of design to the principles outlined above is far broader than at first seems, especially in comparison with current interpretations of circular design.

Literature and practical education materials have appeared from different organizations focused on circular design, including focused on expert method sets and principles, e.g., design for manufacture, design for recycling (den Hollander et al. 2017). Sometimes these discussions extend to deliberations on the circular design of product-service systems (Halstenberg and Stark 2019) and even business models (Saidani et al. 2017). These expert design discussions occasionally allude to broader diffuse design aspects (Bocken et al. 2016; Lofthouse and Prendeville 2018). In general, however, there is limited reference to sustainable development principles (e.g., IDEO and the EMF Circular Design Guide).

Thus, Andrews (2015) and others are correct in saying that design has an influential role in a sustainable circular economy but do not articulate which discourses—technicist or society-oriented—and approaches in expert and diffuse domains. Thus, while we also share with Sumter et al. (2020) the belief that circular design competencies are a new albeit derivative field in need of definition, we differ in our definition of what is required. Following the ten principles for a sustainable circular economy and a broader view of the expert and diffuse contexts for design methods and practices, we offer a more clearly articulated definition of circular design for a sustainability transition than hitherto. Below we exemplify the broader role of design in comparing two roadmap projects in Germany.

6. Comparison Framework: Ten Principles for a Sustainable Circular Economy

Velenturf and Purnell (2021) identify ten principles which highlight and simultaneously describe how to mobilize society, business & industry, and government to develop sustainable circular economy. The benefit of the ten-principle model is that it explicitly combines and articulates ideas and principles of the circular economy and circular society discourses. In general, they define the challenge of integrating circular economy with sustainable development as follows, "Circular economy must be fully integrated with sustainable development. This necessitates a profound reconsideration of the circular economy, broadening its scope from closed-loop recycling and short-term economic gains, towards a transformed economy that organizes access to resources to maintain or enhance social well-being and environmental quality. Superficial changes, i.e., to accommodate recycling, to prevailing economic models will not suffice" (Velenturf and Purnell 2021, p. 1453).

The principles, which they also reference in their discussion, are interrelated, as evident by the description below. Principles 1 to 4—reduced resource flows, decoupling, R-ladder design, and circular business models are mainstream discussion points for circular economy and circular design. Meanwhile, principles 5 to 9 address more radical socio-political changes associated with circular society—consumption transformation, citizen participation, etc. There is clear allusion to sustainability transition in principle 6, albeit with multiple possible outcomes, as indicated by principle 8. Changes must be enabled by participatory design, while principle 9 calls, as we do, for a return to strong sustainability as the foundation of the political economy of change. Principle 10 advocates for system analysis. Of particular interest are the elements in the ten principles, which neither roadmap consider in detail: for example, the reference in principle 9 to political economy or exnovation by government in principle 4.

However, although circular society approaches, such as those outlined below, advocate for co-design and participation of community actors (principle 6)—this is expanded in the ten-principle model to include multiple government, industry and other stakeholders in a way that is not necessarily included in society narratives. It is also clear that in all the principles, there is an allusion to reduced consumption and sufficiency approaches—a concept that is rarely alluded to in circular economy. The ten principles are:

1. Beneficial reciprocal flows of resources between nature and society;
2. Reduce and decouple resource use;

3. Design for circularity;
4. Circular business models to integrate multi-dimensional value;
5. Transform consumption;
6. Citizen participation in sustainable transitions;
7. Coordinated participatory and multi-level change;
8. Mobilize diversity to develop a plurality of circular economy solutions;
9. Political economy for multi-dimensional prosperity;
10. Whole system assessment (cf. [Velenturf and Purnell 2021](#)).

With respect to existing circular design approaches, alluded to above, principle 3 is directly relevant although as described by the authors includes intervention by governments and other intermediaries to promote industrial symbioses. There is a relatively long excursus in principle 3 on the central role of design but one, which conceives of design as far more than a technical discipline. They define design for circularity as,

“Design, select and transform industrial systems, supply chains, materials and products, using ‘R-ladders’ and whole-system assessments of solutions to optimize stocks and the degree of closing loops of resource flows, minimizing raw material extraction and waste generation, optimizing value generated for people, and enabling reintegration of materials into natural biogeochemical processes at end-of-use, through continuous processes nurturing sustainable solutions, through innovation, and phasing out unsustainable practices, through exnovation, to implement and maintain a sustainable circular society”. ([Velenturf and Purnell 2021](#), p. 1455)

Of particular interest is their definition of the design for circularity above, but also their inclusion of other principles involving participation and political change. In the context of multi-stakeholder engagement, these changes can also be designed when one considers current expert and diffuse design roles. In what follows, we examine how and to what extent two circular roadmap projects in Germany address sustainable circular economy principles.

7. Contrasting Roadmap Examples

In the following discussion, we examine two roadmap projects in Germany, which fit the tech-centric circular economy and circular society discourses and visions ([Calisto Friant et al. 2020](#)). In doing so, we note that strict dividing lines between Roadmap visions in Germany are less clear than at first site. Our analysis employs the ten principles of Velenturf and Parnell as framework to ask whether and to what extent such prescriptive principles of change are embodied in both Roadmaps. Secondly, we analyze how both roadmaps consider design and where weaknesses remain in this interpretation relative to a sustainable circular economy.

7.1. Circular Economy Roadmap for Deutschland

The Circular Roadmap for Deutschland ([Circular Economy Initiative Deutschland 2021](#)) was a product of deliberations of the Circular Economy Initiative (CEI) and outlines the steps necessary to achieve circularity in the country by 2030 and beyond. The CEI Roadmap is seen as Germany’s response to the EU Green Deal and Circular Economy policy. This is also noted by agencies such as NABU in Germany who observe the limited implementation of circularity in the country beyond successes with recycling. Supported by the Ministry for Education and Research (Bundesministerium für Bildung und Forschung (BMBF)) and guided by the National Academy of Science and Engineering (acatech) and the Environmental Service Agency SYSTEMIQ, 130 Experts were recruited by CEI to develop the plan, which was published in May 2021. As such, it constitutes a national guide to the circular future of Germany until 2030 and beyond and builds on earlier initiatives linked to sustainable development ([Lah 2016](#)) as well as addressing, in principle, calls for stronger political leadership and clear strategy to achieve circularity as an instrument of broader change in Germany.

In its formulation, the roadmap followed the pioneering roadmap exercise of Finland in 2016, and roadmap projects for other countries ([Asia-Pacific Economic Cooperation 2020](#); [Kłosińska 2019](#); [Schandl et al. 2021](#)) or for particular global sectors, such as the automobile industry ([World Economic Forum 2020](#)). The original Finnish Roadmap Publication was updated in 2019. The World Economic Forum (WEF), in general, dedicates its focus on circularity to business and material aspects. Subsequent to the roadmap, other related reports have been published (e.g., [Weber and Stuchtey 2019](#)). With its aim to combine competitiveness with resource efficiencies through a focus on the whole life cycle of products, CEI and its Roadmap focused on three aspects at the design—product longevity, reparability, and re-use, a longer and more intensive use—and end-of-life phases embodying disassembly for new use, aspects which are mainstream elements of the circular economy narrative.

7.1.1. Positioning the Narrative

Progress towards a circular economy in Germany have been largely understood as and limited to a recycling economy based on unambitious business models and product design ([Rudolph 2018](#)). Hence, discussions in the literature and policy in Germany addressing the *Kreislaufwirtschaft*—a literal translation of circular economy—are often about a recycling economy (*Abfallwirtschaft*) rather than reflecting the broader circular economy agenda in Europe ([Nelles et al. 2016](#)), including transformed business models and new economic thinking, and elsewhere (see for example [Boch et al. 2020](#)).

In their study of policies and strategies in China and the EU, ([McDowall et al. 2017](#)) note that China tends to take a broader focus on environmental and social issues than its European counterparts, who often restrict their focus to business opportunities and waste management. This is generally true of the CEI Roadmap content and a limitation in other countries, including Malaysia ([Asia-Pacific Economic Cooperation 2020](#)), Australia ([Commonwealth Government 2018](#)), where policy and roadmap projects are focused on particular waste product opportunities ([Boxall et al. 2019](#)). The roadmap reflects aspects of many of the principles, although it avoids any direct reference to citizen participation, political and policy action, e.g., exnovation and reduced consumption.

7.1.2. Circular Economy Roadmap Relative to Sustainable Circular Economy Principles

The CEI roadmap sees wide-ranging legislative, business and industry, and economic changes as necessary to achieve circularity by 2030. Inclusion of society in the deliberations for a new economy and the role of governments in incentivizing change through regulation, tax, and policy. Throughout the document is a regular allusion to four levels of change: Product—Business Model—Socio-technical—Social. The socio-technical dimension typically addresses policy and regulation changes and incentives lead by government and other stakeholders to promote change, while the last dimension addresses engaging society through education and involvement in discussions.

Although it mentions social aspects of job creation, except for a brief excursus describing the circular society notion, it has nothing directly to say about principles 5 to 9 above or where there is an allusion to such themes, e.g., reduced consumption. Such changes would be a secondary outcome of instituting the economic model rather than a primary focus. The key to success in the future is presented as a new approach to value chains and circular design in a standard expert design sense. This includes a focus on the R-strategies of re-use and so forth. As with similar roadmap projects elsewhere, there is a focus on product and service sectors, e.g., batteries. Thus, the strategy document is a good example of the tech-centric discourse, albeit recognizing the limitations of this approach and the need for taxation, regulation, and clear assessment measures. The idea that policy and social engagement can be designed is not explicitly noted. Although overall, the strategy calls for pilot projects, leveraging and scaling of existing success models, and a range of direct roles for government in guiding change.

7.2. Reformist Circular Society: Circular Society Roadmap Fuer Deutschland

Consolidating their experience with social design and the circular economy, and position papers and discussions on the notion of a circular society, Hans Sauer Stiftung (HSS) has recently initiated a co-designed circular society roadmap project, which they explicitly describe as associated with the CEI Roadmap, but which expands its agenda through social process and outcomes into a circular society. As noted above, the circular society designation has emerged as a response to perceived limitations in the mainstream circular economy story (Calisto Friant et al. 2020).

In their outline of the ongoing roadmap process, the HSS identifies four key themes for a circular society: circular citizens and societies, open source and open design, collaborative value creation and circular literacy. In each of these themes, as they are discussed, multi-stakeholder (society, industry, government) decision-making respecting ecological boundaries and social inclusion are foregrounded. Similar to CEI the HSS as an organization sees itself as a key intermediary for the circular society transition (Melles 2021).

7.2.1. Positioning the Narrative

In their position paper on paths to circularity (Boch et al. 2020), HSS discuss the value and limitations of the mainstream circular economy and the need to expand the approach to consider social participation and social outcomes. While the topic of engaging society is not absent from the CEI Roadmap and generally acknowledged in the technicist discourse—HSS sees change as a participatory process foremost rather than primarily a business and industry transformation. In so doing, HSS alludes to work on this topic by members of the consortium (Jaeger-Erben et al. 2021) and to the literature on the sustainable circular economy alluded to above (Velenturf and Purnell 2021), which sees a central place for participation and co-design.

Throughout the HSS narrative on circular society, there is an acknowledgment of the circular economy discourse and practices but a shift in focus towards the multi-stakeholder processes that can enable this change. In this respect, their focus on co-design as a process for social innovation is unsurprising (Britton 2017).

7.2.2. Circular Society Roadmap Relative to Sustainable Circular Economy Principles

The HSS Roadmap attempts to offer a corrective to the absence of a social focus in a circular economy, renaming the whole process as a circular society project. For this project, citizen engagement and the participation of government and academics with the Stiftung as intermediaries are at least rhetorically promoted. Similar projects of participation in new economic thinking exist and seek to engage committed individuals. The danger of such approaches is that there is no outreach to those “outside the tent” and the much-needed support from business and industry is lacking.

8. Conclusions

In this paper, we have examined the argument for the circular economy as the engine of sustainability transition and observed that such a position under-represents the circular discourses and possibilities for change. Secondly, we have critically examined the narrow depiction of design’s contribution to change as reflected in current discussions and materials—as well as reflected in the two roadmap projects. We have suggested that a focus on expert and diffuse design perspectives better represents the current contribution of design to sustainability transitions towards a sustainable circular economy. We certainly agree with scholars who see the need for a reimagining of the contribution of design to this project (De los Rios and Charnley 2017), although our response is distinct in seeing expert and diffuse design at work in circular design and circular society but also in the political economy and governance of the sustainable circular economy.

The mainstream circular economy discourse in policy and practice assumes that green growth can be achieved through a decoupling of production and consumption from growth. Within closed-loop technological and biological cycles, technology innovation and design

are also central to achieving green growth—a growth that is assumed to be sustainable. We have seen, however, that the circular economy narrative has many weaknesses as it fails to critique the premise of continuous growth as consistent with sustainable development (e.g., Corvellec et al. 2021). Without clear articulation of the (prescriptive) principles for change towards sustainability through a sustainable circular economy, as in the ten principles model, key aspects of change are absent.

Circular design consistent with these criticisms and as a contribution to sustainable development must be based on these ten principles and not limited to current depictions of circular design as a set of techniques, e.g., design for remanufacturing or modularity, with no clear connections to the socio-technical regimes changes that will lead to strong, sustainable development futures. We concur with Kovacic et al., who conclude that “Circular economy policies would be a success even though the economy cannot be circular if they could inspire and stimulate creativity and entrepreneurship in civil society to develop and prepare steppingstones and building blocks towards a type of civilization that destroys less of the biosphere” (Kovacic et al. 2019, p. 169).

The analytic framework of the sustainable circular economy can be applied to other roadmap and policy formulations on circular economy and society, and this is the practical value of this paper. We suggest that other researchers may wish to analyze processes in other national settings where contrasting discourses and conceptions of design operate. We certainly believe that it will be beneficial to uncover the gaps between a technical solution and a sustainability transition that incorporates all facets of sustainable development.

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