

# Chapter 18

## Circularity in the Built Environment: A Goal or a Means?



Tom B. J. Coenen, Klaasjan Visscher, and Leentje Volker

**Abstract** To reach a circular built environment, the changes and solutions of such mission need to align with the challenges a Circular Economy (CE) aims to solve. Despite the rather uniform policies on the goals and challenges of circular construction, the understanding of CE among practitioners appears divergent. Using the concept of problem space and solution space in relation to missions, the various perceptions, interpretations and framings of the CE mission in the Dutch construction industry were studied by means of 20 semi-structured interviews. Results indicate that the perceptions of the underlying challenges vary from mere resource scarcity to wide societal reforms, including social equity and climate neutrality. Also, the relation with other concepts seems contested, particularly regarding sustainability. The problems CE aims to address and the solutions to reach such CE turned out to interact and even intertwine in the conceptualizations of CE. Mission achievement hence calls for convergence of both the problem and the solution space acknowledging the mission's co-evolving nature. Given the resulting positioning of CE as both a means for underlying challenges and a goal in itself, we propose to understand CE as a mediation concept that couples directed solutions to a wide set of societal challenges. This implies that rather than aiming for a uniform definition, action should be aimed at dynamically guided solutions towards addressing the evolving societal challenges. Further research in other sectoral and geographical contexts is required to explore the validity and implications of CE as a mediation concept.

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T. B. J. Coenen (✉) · L. Volker  
Civil Engineering & Management, University of Twente, Enschede, The Netherlands  
e-mail: [t.b.j.coenen@utwente.nl](mailto:t.b.j.coenen@utwente.nl); [l.volker@utwente.nl](mailto:l.volker@utwente.nl)

K. Visscher  
Department of Technology, Policy & Society, University of Twente,  
Enschede, The Netherlands  
e-mail: [k.visscher@utwente.nl](mailto:k.visscher@utwente.nl)

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## 18.1 Introduction

Circular Economy (CE) has become one of the major themes in the construction industry, especially due to the large use of virgin resources and waste in the sector (Benachio et al., 2020). Addressing various challenges, particularly in line with SDGs 11 (sustainable cities and communities) and 12 (responsible consumption and production), the CE concept has been operationalized through the articulation of a mission. Such missions can be understood as narratives for challenge-oriented change (Janssen et al., 2021). In this respect, missions have increasingly been connected to directing system transformation in line with the societal challenges (Schot & Steinmueller, 2018). To achieve such missions, the direction of the underlying challenges (problem space) and required changes and innovations (solution space) need to be aligned (Wanzenböck et al., 2020). While CE has been introduced as a mission to address several underlying goals and challenges in the environmental sustainability domain, scholars have been defining CE in various ways, most notably considering resource flows, either or not including economic aspects (Kirchherr et al., 2017). This includes various ways for circular futures to take shape (Bauwens et al., 2020). However, CE has been widely regarded as an essentially contested concept (Korhonen et al., 2018b). Next to the conceptual critiques on feasibility and effectivity (Corvellec et al., 2021), its variety of discourses and myriad of framings adds to the concept's elusiveness (Calisto Friant et al., 2020), which impedes an effective mission attainment (Janssen et al., 2021).

While CE has experienced huge advancements in academia in terms of operationalization, conceptualization and adoption (Goyal et al., 2021), most research in the CE construction context addresses (technological) solutions (Benachio et al., 2020). Charef and Lu (2021), nonetheless, showed that, next to changing the thinking of professionals and novel technologies, a change of policy and regulation for adoption and implementation of CE is needed. For example, standards for circular construction need to be established (Anastasiades et al., 2021). Many framings and interpretations exist on the meaning of CE throughout the sector (Hossain et al., 2020), which is a major barrier to the transition to a circular construction sector. At the same time, implementation depends on the perceptions, interpretations and framings in practice. To determine and eventually steer the directionality of the solutions, it is of critical importance that the understandings of the CE concept are aligned and convergent in construction practice.

Considering the contradiction between the aim of alignment and convergence of missions and the essential contestation of the CE concept, we study the potential of CE to provide direction of change in line with societal challenges in the construction context. To that end, we analyse the framings and interpretations of the problem space, solution space and interactions as perceived by professionals in the Dutch construction sector in light of the formal mission policies. This approach reveals,

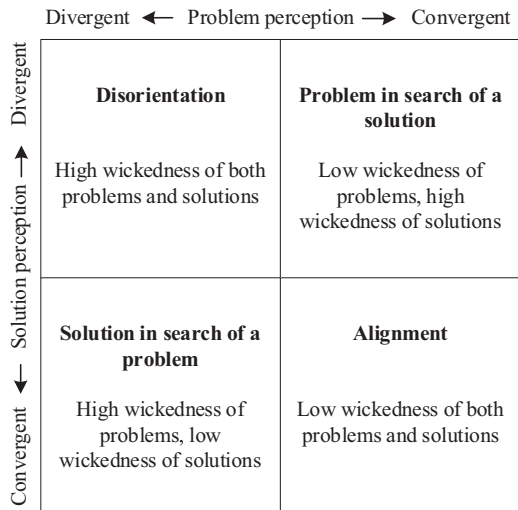
for example, how CE is perceived in the construction context and to what extent CE is seen as a means or as an end. Next to insights into the framings and alignment of CE in the Dutch context to support CE policy, we aim to contribute to the ways of understanding and positioning the CE concept in academia and how future research in circular construction should deal with the equivocality of the concept.

## 18.2 Theoretical Framework

Societal missions have become increasingly important in innovation policy to guide change and innovation into societally desired directions. These missions are not only considered *wicked* but also constitute a wide heterogeneity of problem structures and specific designs of solutions with respect to these challenges (Wanzenböck et al., 2020). Therefore, these should be seen as “open-ended, [...] concerning the socio-economic system as a whole, even inducing (or requiring) system transformation” (Kuhlmann & Rip, 2018, p. 450). To guide and steer system change in the direction of missions, the concept of mission-oriented innovation policies (MIP) has been introduced. According to Wanzenböck et al. (2020, p. 475), “[a] MIP should be seen as a policy that provides directionality in supporting the process towards converging problem–solution constellations [and] aims at advancing problem–solution constellations which become sufficiently stable to serve as common frame of reference for actors.” Hence, the convergence of problem–solutions space guides the directionality and attainability of missions.

To conceptualize the underlying problem–solution structure of missions, Wanzenböck et al. (2020) presented a framework with two axes comprising the level of wickedness of both the problem and the solution space (Fig. 18.1). By studying the perceptions of the problem and solution spaces separately as well as by

**Fig. 18.1** Four types of problem–solution spaces. (Adapted from Wanzenböck et al. (2020))



analysing their interactions, the problem–solution perception in the current stage of transition towards circular construction can be investigated. Here, the problem space is determined by the level of normativity, complexity and available knowledge, while the solution space is characterized by contestation of the feasibility and prioritization of solutions, the alignment of solutions with the existing system and fragmentation of the various solutions. The resulting quadrants are: (1) disorientation in which both the problems and solutions are highly wicked such as social justice; (2) problems in search of solutions such as bullying; (3) solutions in search of problems such as spaceships to Mars; and (4) alignment between problems and solutions such as water retention. Depending on the blurriness between the problem and the solution space, mission alignment can either or both be reached through problem-led directionality and solution-led directionality. This implies a variation in pathways to increase the convergence and alignment of missions (Wanzenböck et al., 2020). Given that MIPs aim to converge towards an aligned framing (lower right quadrant), we use the framework to analyse the CE as a mission in the Dutch construction industry using the problem–solution axes.

### 18.3 Research Approach

To analyse the consequences of the variation in framings of the CE concept, we studied the Dutch context, where CE has since 2016 been positioned as one of the central pillars of environmental sustainability policy. We have focused the research on the perceptions of CE in construction practice to study the alignment and convergence of the CE mission interpretation in the Dutch construction industry. Following Wanzenböck et al. (2020), we distinguished the challenges addressed by the mission from the priorities of and interactions between the solutions for achieving the mission. Together, these interacting dynamics take place in the problem–solution space as addressed in Fig. 18.1. Accordingly, we took the following research steps.

First, we have mapped the development of CE policy in the Dutch construction context by means of an analysis of grey literature. This enabled us to reflect upon the relation between the formal policies and interpretations and framings in practice. Next, we identified the various perceptions and interpretations of the societal problems CE aims to address in the sector and the potential solution pathways connected to it by means of semi-structured interviews. Using purposive sampling (Campbell et al., 2020), individuals were selected such that both the various subsectors and the actor types were covered, which resulted in a diverse representation of the sector. To reach this actor variety, we used the innovation system categories presented in Kuhlmann and Arnold (2001). This resulted in interviews with 20 individuals with varying levels of experience with CE, consisting of two market parties, three policy makers, four public clients, two scholars, two network managers, four engineering/consultancy firms and three individuals from boundary organizations such as financiers and legal specialists (see Appendix). Although the interviews were conducted as open conversations, several indicative questions were used to start and to guide the conversations (Table 18.1).

**Table 18.1** List of indicative interview questions

<i>Problem space</i>	What does CE mean to you? And what societal challenges does it address?
	Who determines and affects what CE means?
	How does CE relate to other missions? And is there overlap with other missions or societal challenges?
	Is there, in your view, consensus on the meaning of CE?
	How is this problem interpretation related to the formal strategy?
<i>Solution space</i>	What are the ultimate solutions for circular construction?
	Who affects the solutions? And who determines what solutions become dominant?
	What are the roles of government and market in the solution space?
	To what extent are solutions introduced and adopted successfully?
<i>Problem–solution interaction</i>	Are the current developments sufficient to achieve the mission goals?
	To what extent do solutions address the mission goals?
	Should the CE mission be addressed integrally or separately with respect to other missions and challenges?
	How do the problem and solution spaces interact?
	How do the solutions feed into the problem space?

The transcripts of the 20 interviews were qualitatively coded in the Atlas.ti software tool. The interviewees' quotations were linked to the three separate categories presented in Table 18.1, being problem space, solution space and problem–solution interaction. The former two focus on both the level of convergence of the framings and the latter addresses how those spaces affect each other. Next, we compared the quotations per theme to find the framings of the CE mission, as well as their diversity. The final step was to link those overviews to the formal strategies to analyse the alignment of practice with the formal strategies. Altogether, this led to the results presented in the next section. First, we introduce the mission as formally stated in the Dutch national policies and strategies. Second, we present the interpretations and framings in practice based on the interviews, distinguishing the problem space, solution space and problem–solution interaction. Quotations were translated into English by the authors.

## 18.4 Results and Analysis

### 18.4.1 Mission Context: Circular Construction by 2050

The Dutch government was one of the first to launch a national mission for CE in Europe (Giorgi et al., 2022). The mission was formally introduced in 2016 and aimed for the Netherlands to be circular in 2050, meaning: (1) high-grade use of existing resource and waste flows; (2) replacement of fossil and non-sustainably produced resources by renewable and widely available alternatives; and (3) redesign of production methods, products and domains and rethinking consumption (IenW

and EZK, 2016). Although building upon existing waste policy, the CE mission was introduced rather radically. CE was in the first strategy report already presented as an imaginary to mobilize action for directed change: “The idea of a Circular Economy as a fully closed system is a mobilizing ideal image. The use of primary resources and the generation of waste flows can probably never be fully prevented” (IenW and EZK, 2016, p. 15). Transition agendas were developed for five priority domains, including construction. Each priority sector was considered a separate pathway and Transition Teams were established to direct and lead the transition towards a circular system by formulating transition agendas and policies. Four strategic priorities have been identified in the transition agenda for construction, being market development, measurement of CE, policy and legislation, and knowledge and awareness.

In parallel to this formal strategy, in 2017, a large, industry-wide platform (CB’23) was launched by two governmental organizations and a normalization institute. This platform aimed at wide sectoral participation to uniformize the understanding and operationalization of circularity in the Dutch construction industry, which also affected the formal policies. Gradually, the goals and definitions found in the policies, strategies and networks shifted in focus. While the initial goals strongly approached CE as a means to address material scarcity and resource supply risks, the formal goals for the construction industry became increasingly integral, widening the formal CE mission to issues such as the pollution (particularly CO<sub>2</sub> reduction), biodiversity and environmental impact.

### 18.4.2 *Problem Space*

The previous section indicates that CE is positioned in the Dutch construction context as a “promise” rather than a clear description of challenges or goals. However, the challenges and goals addressed by the mission were perceived remarkably divergent. The interviews revealed different takes on how this imaginary is substantiated in practice, not only through the formal strategies but also through the practitioners’ personal experiences and framings.

Several interviewees explicitly stated the need to distinguish CE from circular construction. According to them, CE is about the transformation of society at large towards a future circular system, while circular construction should be directed at resource/material efficiency in the built environment, with other environmental benefits as indirect benefits. One consultant explained: “[*in contrast to CE, circular construction*] is specifically about the inexistence of waste and that all resources are put in the resource to be reused at a high grade.” However, most of the interviewees did not explicitly distinguish between CE and circular construction, but their interpretations resonated with the notion of the latter. This addresses primarily the reduction of primary materials as the focus of circularity and is in line with the definition provided by the Transition Team. Apart from the noted differences, this indicates a rather subconscious interpretation of the CE concept and its underlying challenges.

When digging deeper into the societal problems that are addressed by these reduction efforts, only two interviewees mentioned resource depletion or material supply risks as a primary challenge. All the others saw circularity as a means to reduce the wider environmental impact, including emissions, biodiversity and social equity, as well as economic impacts such as long-term cost reductions and labour efficiency. Moreover, CE was linked to the deteriorating state of infrastructure and the housing shortages that call for large-scale construction or replacement activities in the coming decade. Interviewees argued that linking this building, maintenance and replacement challenge with circularity principles could increase the feasibility and reduce the costs while addressing sustainability goals. For example, a public client noted: *“The focus is increasingly shifting towards replacement and renovation [of assets]. That means that asset management is becoming more prominent in the steering on [circular] measures.”* It turned out that the interpretations of CE of practitioners closer to the national CE policy in government organizations were strongly aligned with the formal strategies, while the more deviating interpretations were found in market organizations. In sum, there was a large variation of the specific societal challenges that were expected to be addressed by CE. Despite this apparent contestation, three interviewees surprisingly perceived consensus on the problems that CE addresses, which indicates an unknown struggle for convergence of the various framings.

The relation and integration to other missions and their challenges was perceived divergently too. Whereas most interviews agreed that CE should always be considered in relation to wider sustainability issues, because the underlying goal – reducing environmental impact – is similar, there was considerable disagreement on the extent to which CE must be considered either separately or integrally from a governance perspective. Some interviewees urged for considering CE as a “way of thinking” that is inherently sustainable, while other stressed to limit CE to the scope of circular construction, and, as such, to focus on resource flows. One consultant even considered CE to be the materials part of sustainability, indicated by: *“How can we do things circular in terms of materials, but also do it sustainable in terms of CO<sub>2</sub> emissions? In this way we weigh various sustainability aspects.”* Apart from the conceptual interpretations, several interviewees mentioned the dilemma between conceptual purity and pragmatism in terms of governability. To illustrate the coupling of CE to the wider sustainability topic in order to be eligible for funding, a policy officer noted: *“we didn’t get funds for CE in 2017, but we coupled it to the climate goals, [because] if we start working circular, we will contribute to the CO<sub>2</sub> reduction targets. [...] Such coupling increases the urgency of and support for CE.”*

Altogether, the interpretations and framings of the problem space are divergent. Not only do the underlying challenges differ but also the scopes differ in extent and direction. It is hence unclear how CE relates to other missions and how the responsibilities should be allocated. This indicates a high wickedness of the problem space.

### 18.4.3 Solution Space

Construction works and innovations are, especially in the infrastructure domain, predominantly developed by market parties as a response to (public) tenders. However, it is in such tenders that the CE concept is operationalized into solutions. As indicated in the paragraphs below, the types of innovations, other social and processual changes and their priorities are contested too.

According to all interviewees, operationalization of CE is still fragmented and the solutions depend on the varying client specifications. As illustrated by a contract manager from a market party: *“despite the ambition to be [the Netherlands’] most circular contractor, we need to address client’s specifications in tenders in order to win those.”* Nevertheless, clients and public organizations increasingly support and participate in initiatives that investigate specific innovations. Although there are many circular alternatives developed since the introduction of CE policy, according to a public manager, *“the strategies and design principles are not that much under debate anymore, but the degree to which these ought to contribute to solving the problems is still contested.”* According to a sector banker, the share of supply-driven circular solutions in building construction is higher than in infrastructure due to the sector’s structure. In building construction, there are several upscaling developments in modular and industrial housing innovations. This indicates a low but increasing convergence of circular innovations.

On a more abstract level, solutions were mentioned by the interviewees in terms of, for example, reuse, avoiding materials and recycling quota without specifying the (technological) solutions to do so. The formal policies also include a hierarchy of these abstract strategies, which are operationalized in the R-ladder,<sup>1</sup> which was mentioned by three interviewees. For example, a public manager stated that *“we try to find solutions [in the market] as high as possible on the R-ladder in order to retain as much value as possible in our assets.”* Still, there remains a discussion on the extent to which such hierarchy should be used to rank or assess solutions or to direct the transition. While various interviewees stress the necessity to aim for as high as possible R strategies, others argue that this does not always lead to solutions that address underlying problems most effectively. Moreover, the interpretations of strategies, such as the difference between reuse and recycling appear equivocal too. Nevertheless, there seems to be consensus that on this abstract level, different types of solutions apply to different types of construction assets, particularly distinguishing bulk materials (e.g. asphalt, concrete) from other resources. There is hence no single CE strategy that applies to all construction assets.

When addressing the solution space, all interviewees mentioned changes and innovations that facilitate processual and social changes that allow for technological solutions. As a consultant mentioned: *“I think the biggest challenge is to look [at CE] as a system transformation rather than technological innovations.”* In the

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<sup>1</sup>The R-ladder consists of a hierarchy of waste management strategies in which certain activities are considered more circular than others. Examples of such Rs are Reuse, Reduce, Refurbish and Recycle (Potting et al., 2017).



infrastructure context, many interviewees mentioned that reconsiderations in asset management are fundamental for becoming circular from a systemic perspective. To exemplify, a public client's manager remarked: *"If you treat stuff properly it lasts very long, but [...] asset managers do not realize that CE is an obvious element of asset management."* Also, data management and data transparency were mentioned in both building construction and infrastructure to play a crucial role in making circular decisions, for example, *"[it can only be treated circular] if it remains digitally insightful what materials are used in buildings, what the quality is, [...] and which dimensions are used."* Such data include as-built drawings, structural monitoring data, and changes to and renovations of the asset to allow for circular choices in later lifecycle stages of the asset. Another condition mentioned for operating circularly depends on client–contractor relationships. This includes procurement methods (i.e. offering the space for circular innovation), but, even more, building relationships and collaborations that align the incentives between actors for considering whole lifecycles of assets. A researcher argued: *"Circularity is partly innovation, but largely not-so-innovation; namely, effectively using stuff that is already there. [To achieve this,] the strictly contractual relationship between client and contractor needs to be dropped to go to more constructive [relationships] to put actors in their strengths."* Despite the agreement on the need for conditional changes, the extent to which and by whom those need to be enforced are still under debate. However, both market parties and public clients express a leading role for government organizations.

Similar to the problem space, the perception of the solution space shows a divergent image with a high level of fragmentation throughout the sector in terms of dominant solutions for a successful transition towards a circular infrastructure sector. Although interviewees all have images on circular futures, those images differ. The interviewees show yet an increasing understanding of the systemic implication of circularity beyond technological "add-ons," particularly in larger organizations. However, the structural aspects of the sector pose major barriers to achieve such solutions on an integral and systemic level. Nevertheless, there are several promising initiatives, particularly launched by large public organizations and networks.

#### **18.4.4 Problem–Solution Interaction**

Problems and solutions interact in the context of a mission. After having established that the problem and solution spaces are both wicked, the interaction will have a major impact in the evolvment of the mission. Various types of interactions are discussed below.

The level to which CE was perceived as a goal rather than a means to address underlying challenges was remarkably high. As a CE researcher stated: *"I have never consciously thought about it before, but there seems to be a shift from CE as a means to CE as a goal in itself."* This was also implicitly confirmed by many interviewees. For example, CE has, according to a policy maker increasingly become a strategic pillar next to, for example, sustainability rather than under it.

Still, it is often presented as a solution for various other (societal) challenges. Specifically in the operationalization of CE in projects or specific products, circularity is interpreted as a goal serving other challenges. As an asphalt expert illustrated: *“when acting circular by reusing more asphalt, the overall CO<sub>2</sub> emissions will also drop.”* Within the set of interviews, it was visible that professionals with more experience and expertise in CE see circularity as a means, while professionals newer to the subject tend to consider it as a stand-alone objective.

A striking observation in the interviews was that, rather than considering it from a problem perspective, several interviewees explicitly defined CE in terms of solutions, most notably in terms of modularity and reuse. For example, a sector banker stated that: *“in CE, you try [...] as much as possible to take the reuse and lifespan extension of materials into account.”* This illustrates a blurry line between the problem and the solution space. The same goes for the R strategies, which are by some presented as solutions to become circular and by others as targets to develop solutions for. It indicates a co-evolution between the spaces. This co-evolution was also acknowledged by a network manager: *“I think if we want to start seeing CE as the new normal, we need to collectively live through it. We just need to put it to work to start understanding what the implications are and to synchronize towards a common perception.”*

For these reasons, several interviewees argued that it is not fruitful to aim for a fixed and all-encompassing definition of CE or circular construction, nor to define fixed problems and solutions. As indicated by a network manager: *“I have never believed in such uniform definition. [...] The focus should instead be on turning it from an elitist sport to something for the masses and on moving people into the right direction.”* A researcher added: *“if we keep adapting the definition of what a 100% CE means, we will eventually get there, but if we stubbornly hold on to the current definition, we won’t.”* This illustrates the evolving character of the CE concept, which can be at times converging, but also diverging. Nevertheless, about half the interviewees explicitly mentioned the necessity for a uniform definition, most notably because of the measurability of progress and the political legitimization.

In conclusion, some interpret CE as a challenge in itself, while the majority is increasingly seeing it as a means to address underlying challenges. Nevertheless, there is shared perception that CE as a concept is still developing, not just in terms of solutions but also conceptually.

## 18.5 Discussion

Results show that the problem and solution spaces of CE in construction are both wicked. Many interpretations of the problem space do not only vary among respondents but also when compared to literature on CE in construction (e.g. Hossain et al., 2020). The problem and the solution space interact in an unpredictable way. Applying this to the four quadrants (Fig. 18.1), the mission finds itself in a disoriented stage and evidence of a process towards an increasing alignment was not found.

Hence, an effective transition towards CE requires learning about the problem while experimenting with solutions, following a co-evolutionary logic (Wanzenböck et al., 2020). A practical example of this co-evolution was confirmed in another study considering the case of the pilot project on the development of a Circular Viaduct in the Netherlands (Coenen et al., 2021). In line with our findings, the viaduct case shows that while the pilot was designed according to the best knowledge of making it circular at the time, the outcome of this process – the design – also affected how others in the sector interpreted CE. As suggested in the Result section, the meaning of circularity in the construction context must be discovered and converged by experimenting and learning with solutions. Despite the exploratory nature of this venture, coordination of the solutions is necessary to achieve this alignment and to provide direction and share knowledge and insights from a policy perspective (Mazzucato et al., 2020).

Because this notion of CE fits the conceptualization of a super-wicked problem (Levin et al., 2012), CE is becoming a discursive resource to guide framings in addressing other challenges, such as climate change (Green & Sergeeva, 2020). This fits the purpose of the mission as a narrative for guiding and coordinating directed change (Janssen et al., 2021). Nevertheless, this overlap limits the power of CE as a mission because the CE does not simply offer a narrative for coupling challenges to solutions. Instead, it acts as an intermediary concept by offering an ideal view of a configuration of society (Kirchherr et al., 2017). However, results of our research indicate that, while acknowledging the CE as a societal transformation, circular construction is rather seen as a way of doing things more resource efficient – especially regarding the reduction of primary resources. Such activity-based view of CE has obvious limitations in terms of conceptual purity and possibly also for the transformation potential. In other words, recycling more, reusing more and building modularly, will not lead to a regenerative, closed-loop system (Korhonen et al., 2018a). Moreover, such framings are fundamentally different from the economic and political conceptualizations that challenge the current consumeristic system itself (e.g. Lowe & Genovese, 2022). Nonetheless, the solution-oriented interpretations offer action perspective to actors needed to explore the problem space.

Although the societal challenges mentioned (e.g. resource depletion and carbon emissions) underpin the various interpretations of CE, results indicate that the concept is treated as a goal in itself too. Considering it as a target helps in guiding change into a specific direction and hence to position it as a mission. Inspired by Jasanoff's socio-technical imaginaries (Konrad & Böhle, 2019), we hence propose to understand the CE as a mediation concept. This means that, as an ideal imaginary, CE has a mediating role between systemic change and societal challenges. As an illustration, this means that, when considering it as a mediation concept, a designer does not need to understand the full implications of the societal challenges that CE aims to address to contribute to addressing those challenges, while policy makers do not need to steer the actual solutions as long as the CE principles relate to the underlying challenges.

As a guide to change in practice, such mediation concept helps to tackle an interacting set of societal challenges without the need to understand the full complexity of them. This implies that the interpretation of the societal challenges is, through the

CE concept, affected by circular solutions, while the circular solutions, in turn, are operationalized through CE and substantiated by the underlying challenges. Such conceptualization contradicts the many definitions and operationalizations of CE in literature and practice, because these assume mostly a rather clear interaction between the problems it addresses and the solutions that aim to solve these, such as the closing and narrowing of the loops (e.g. Geissdoerfer et al., 2017; Kirchherr et al., 2017).

## 18.6 Conclusions

To reveal the potential of CE in construction to guide change in line with wider societal challenges, we studied the relation between the articulation of the CE mission in the Dutch construction policies and the perceptions of the problem and the solution space of this mission in construction practice. We found that while the policy documents provide generally clear terms and uniform conceptualizations, the framings in practice vary strongly, even among the more CE-experienced practitioners. This leads to a disoriented problem–solution space. Results indicate that the interpretations of the problems and solutions regarding CE co-evolve. This demands an experimental yet coordinated approach to circular solutions to explore the conceptual implications of the problems addressed by CE. Overall, the understanding of CE in the Dutch construction industry is narrower than the interpretations of CE in literature and can be understood as circular construction rather than CE. In both policy and in practice, the focus is primarily on resource-reducing practices to address not only resource scarcity but also reduction of wider environmental impacts and loss of biodiversity (SDGs 11, 12, 13 and 15).

The inherent contestation of the CE concept, which was confirmed by the case results and becomes transparent when positioning CE as a mediation concept, has implications for mission-oriented policies. The CE concept contributes to aligning the various perspectives with those challenges and, consequently, narrowing the solution space by offering a long-term yet evolving ideal imaginary. Although being instrumental in addressing a wider set of underlying challenges, it is essential to define the conceptual boundaries of CE from a policy perspective. Entanglement of the problem and the solution space, subsector-specificity and inability to envision the eventually dominant solutions hinder the formulation of uniform objectives. Given that construction is a highly demand-oriented sector with a major public clientship, public policy should focus on the formulation and operationalization of long-term objectives. This requires, on the one hand, the inclusion of the market to safeguard feasibility of the objectives, and, on the other hand, the clients' preparedness to let go of actors that do not take the required steps.

This study was based on 20 interviews in a single context. Extending the sample, for example through surveys, would give more insights into the variation of interpretations and framings of circularity in construction. Furthermore, the results indicate a large sectoral and geographic element in the framings of CE. However, the

current study is limited to the framings in the Dutch construction context, while the nature and diversity of framings might be different in other countries or contexts. Doing similar research in other sectors, regions and countries would help understanding the CE as a mediation concept, would increase generalizability of the results and would reveal insights in the opportunities for steering for circularity in order to address a wide set of societal challenges. Such research would also inform on the cross-sectoral alignment of the CE concept with respect to the addressed challenges and potential solutions.

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## Appendix: Anonymized Overview of Interviewees

No.	Interviewee type
<i>Public client organizations</i>	
1	Programme manager infrastructure at Dutch province
2	Programme manager infrastructure agency
3	Programme manager infrastructure agency
4	Policy coordinator water board association
<i>Ministries</i>	
5	Coordinator, Ministry of Interior and Kingdom Relations
6	Policy officer, Ministry of Infrastructure and Water Management
7	Coordinator, Ministry of Infrastructure and Water Management
<i>Industry</i>	
8	Consultant sustainable and circular construction
9	Consultant sustainable and circular construction
10	Consultant sustainable and circular construction
11	Sustainability coordinator contractor organization
12	Project coordinator contractor organization
13	Consultant sustainable and circular construction
<i>Knowledge institutions</i>	
14	Asphalt expert independent research organization
15	Circular infrastructure scholar
<i>Network organizations, platforms, and associations</i>	
16	Director circularity network organization
17	Sustainability manager industry association
<i>Financial, legal and process experts</i>	
18	Economic expert sustainable construction
19	Legal expert sustainable construction
20	Standardization expert

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