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The Role of Financial Actors in the Circularity Transition from a 'Multi-Level Perspective'

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Abstract

Introduction

The circular economy (CE) has been identified as a promising approach to contribute to sustainable development. However, moving from a linear to a circular system requires steering capital away from unsustainable linear practices towards sustainable circular ones. Hence, finance as a provider of financial resources for companies can significantly influence the direction of the transition by choosing what is being financed. However, the role of finance in the CE transition has not yet been studies in greater detail. To extend this field of research and to determine what can be expected from finance in the CE transition, this study investigates the role of two financial actors in the transition to a CE. The focus lies on large *public equity funds* financing companies of the dominant system and *venture capitalists* (VCs), financing circular novelties in start-ups.

Theory

The multi-level perspective (MLP) serves as an analytical framework in this thesis to investigate the transition from a linear to a circular system. Moreover, circular economy business models (CEBM) and design strategies are conceptualized to empirically investigate which circularity practices are funded by the investors under research.

Methods

A content analysis is applied to investigate the role of the public equity funds in the transition. The aim is to find out in what types of CEBMs and design strategies the investigated funds invest. For this, 186 companies that are funded by five different funds with a particular focus on the CE are analyzed.

Moreover, 12 interviews with participants working in VCs with a CE focus are conducted to determine their motivations and incentives to invest in CE-related start-ups.

Results

The results of the content analysis reveal that public equity investors primarily invest in rather incremental CEBM like recycling. Moreover, only a few companies they invest in have a fully CEBM, while most of them predominantly still have linear practices in place.

Furthermore, the results of the interviews show that VCs are mainly motivated to generate short-term profits incentivized by their own investors.

Discussion/conclusion

This thesis concludes that the CE provides interesting investment opportunities for both types of investors. However, their investment decisions are still dominated by orthodox assessment criteria, which are based on profit-maximization. These criteria represent the current dominant system. Therefore, the direction of the transition supported by the investors is influenced by established standards of the dominant regime, which make a radical transition through the investments of the financial actors unlikely.

TABLE OF CONTENTS

List of tables

List figures

List of abbreviations

Abbreviation	Definition
BM	Business Model
CE	Circular Economy
CEBM	Circular Economy Business Model
GP	General Partner
LP	Limited Partner
SD	Sustainable Development
VC	Venture Capitalist

Introduction

The impact of human-driven changes on the environment has reached a state that raises concerns about the future of the planet (Steffen et al., 2007). Human actions could push the earth's systems outside of a stable environment in which essential services for future generations that ensure a viable human civilization cannot be provided. Crossing these planetary boundaries would mean leaving the planet's safe operating space for humanity and all other living beings on earth (Rockström et al., 2009).

Many of the underlying actions that cause these problems are of economic nature and comprise for example, unsustainable production and consumption patterns (Köhler et al., 2019). To address these problems, an improvement of the current system by technological fixes is considered as not being sufficient and instead, it requires radical changes to a new system which is referred to as a 'sustainability transition' (Köhler et al., 2019).

The current economic system is based on a linear consumption, where resources are first extracted, then processed into finished products, which eventually become waste and end up in the landfill where barely any value remains (Urbinati et al., 2017). This system makes resource exploitation very lucrative, and consequentially, environmental degrading activities dominate the economy (Clark et al., 2018). Particularly, due to the forecasted growth in global population and consumption, the principles of the linear economy are expected to increasingly cause sustainability related issues. This includes primarily environmental and economic problems like an excessive waste output, a natural system that is not able to tolerate the increasing level of resource exploitation, and a growing scarcity of resources (Sariatli, 2017).

A concept that has been identified to address these issues and foster the sustainability transition by decoupling economic growth from resource use is the circular economy (CE). Such an economic system opposes the linear economy by replacing it with a closed system in which resources are reused and kept in loops of production and consumption to extend their value over a longer period of time (Urbinati et al., 2017). As a result, the principles of the CE can address some of the prevailing issues of the current system. For example, the concept promises to reduce waste production through reducing measures and to lower the dependency on raw material inputs through extending the resource value (Bocken et al., 2016; Geissdoerfer et al., 2017; Sariatli, 2017). Hence, the CE is viewed among scholars as well as

practitioners as a serious opportunity in the sustainability transition to achieve sustainable development (SD) (Corona et al., 2019; Geissdoerfer et al., 2017).

Even though the CE can contribute to SD, the concepts differ in some regards. For example, SD comprises a social, environmental, and economic dimension, whereas the CE is mainly benefits the economy and environment while social aspects are addressed rather indirectly (Geissdoerfer et al., 2017). Schroeder et al. (2019) describe the implementation of a CE in this context as a "toolbox" to achieve a sizeable number of sustainable development goals.

For the transition from a linear to a circular system, businesses have been identified as crucial contributors and drivers for such change (Chen et al., 2020). Within this firm perspective on the CE transition circular economy business models (CEBM) are of particular importance as the implementation of practices that aim to use resources in multiple cycles usually affects how a company creates value and must be operationalized on an organizational level (Hofmann, 2019; Kirchherr et al., 2017; Lüdeke-Freund et al., 2019; Palmié et al., 2021; Seles et al., 2022). However, the transition to a CE is not yet very advanced (Henry et al., 2020), and especially on a firm level a lack of finance is an obstacle for companies to implement CEBM (Aranda-Usón et al., 2019; de la Cuesta-González & Morales-García, 2022; Rizos et al., 2016). Therefore, finance as a provider of capital a resource can be considered as a crucial driver of the CE transition (Mazzucato, 2013; Naidoo, 2020).

On a company level, finance can influence the a firm's innovation process since the access to financial resources is seen as a necessity to be innovative (Mazzucato, 2013). This emphasizes the importance of finance for companies that are engaged in the CE transition through CEBM innovations. In fact, in the field of sustainability, finance has already been increasingly interested in the topic through the integration of Environmental, Social, and Governance (ESG) criteria in the portfolio management (Friede et al., 2015; Nykvist & Maltais, 2022). According to a Bloomberg report, assets that fall into these criteria could exceed $53 trillion by 2025 accounting for one third of the expected worldwide portfolios under management (Bloomberg Intelligence, 2021). From a sustainable transition perspective, such a development is promising as the transition requires the re-allocation of capital from unsustainable practices towards novel solutions with a focus on their environmental and social performance (Geddes & Schmidt, 2020; Mazzucato, 2013).

In contrast, a recent investigative project conducted by a team of European journalists reviewed more than 800 investment funds labeled with the highest ranking of the sustainability assessment of the EU's Sustainable Finance Disclosure Regulation. Their work revealed that almost half of these funds invest in rather unsustainable businesses like fossil fuels or aviation (Follow the Money, 2022). Hence, there is a real risk that, despite the increased focus on ESG criteria, finance is still providing capital to industries that contribute to the prevailing environmental and social issues.

From a CE transition perspective, the risk that financial actors keep going with their conventional practices could have a significant influence on the transformation. Especially, since such practices focus on short-term profit maximization rather than promoting environmental or social value creation through CE practices (Nykvist & Maltais, 2022). Hence, this thesis aims to contribute to understanding the role of finance in the CE transition to extend the knowledge on what can be expected from financial actors in the transition to a CE. Consequently, the thesis addresses the following main research question:

RQ0: What is the role of different financial actors by size in the CE transition?

Transitions have been conceptualized as complex multi-dimensional processes between a system's micro- meso- and macro-level (Geels, 2011). Within the finance and transition literature, only a few articles have investigated the role of finance in transitions while most of them took a rather holistic system perspective (Geddes & Schmidt, 2020; Mazzucato, 2013; Naidoo, 2020). In contrast, in this thesis, two specific types of financial actors are investigated, which follows a call to integrate more actors and agency in transition studies (Fischer & Newig, 2016; Hörisch, 2018).

The first type of financial actors that are investigated in this study are *public equity funds*. These investors typically invest in companies that have reached the commercialization stage and are established in the existing system (Polzin, 2017). In a recent study, Nykvist & Maltais (2022) found that, despite focusing on sustainability, these financial actors are mainly interested in making risk-adjusted returns. Nevertheless, the incumbents they invest in can influence a transition in several ways (Fischer & Newig, 2016). Hence, this study systematically collects information on the type of circular strategies on a firm level the capital of the investors is flowing to. In total, 186 companies in which five different funds with a particular CE focus invest are analyzed. This information bears relevant insights as what is being financed can

significantly influence the direction of a transition and thus determines how the funds are engaged in this transition (Mazzucato & Semieniuk, 2018). This leads to the following sub-research questions:

RQ1.1: In what type of circular economy business models and design strategies are current circular investment flows of public equity funds going?
RQ1.2: What kind of implications do these investment flows have for their role in the transition towards a circular economy?

Although incumbents have the ability to influence a transition, it is usually start-ups and entrepreneurs on a firm level that develop novelties that accelerate the transformation (Geels, 2011; Henry et al., 2020; Hörisch, 2015). Due to their high-risk profile, start-ups usually do not receive finance from bigger investors like the investigated public equity funds but rely on smaller investors like the second type of investors in this thesis, *venture capitalists* (VCs) (Moore & Wüstenhagen, 2004).

Much literature has acknowledged the positive influence VCs can have on the development of start-ups to young companies as well as their contribution to green growth (Bocken, 2015; Maiti, 2022; Moore & Wüstenhagen, 2004; Randjelovic et al., 2003). However, there is a lack of studies investigating *why* VCs invest in start-ups with a circularity focus. Nevertheless, understanding the motivations and incentives behind their engagement in this type of finance provides insightful information on what to expect from the investors in the transition (Nykvist & Maltais, 2022). Hence, the following second sub-research questions are addressed in this thesis:

RQ2.1: What are the motivations and incentives for VC to invest in CE related business models?
RQ2.2: Which implications do the motivations and incentives have for the VCs' role in the CE transition?

This thesis contributes to several components of the literature. Converning RQ1.1. and RQ1.2, this study follows the criticism by Kirchherr & van Santen (2019), who state that there is a lack of empirical N-studies in the CE literature. By addressing this criticism, this thesis not only expands this research field but also provides impactful insights for practitioners. For example, by showing what is currently being financed in the CE space, lessons can be drawn for managers regarding which CE practices are considered attractive by the financial market.

On the other hand, policymakers gain insights on the direction of the CE transition that is currently being financed. This knowledge enables them to formulate effective strategies to guide the transformation in the intended direction during its early stages.

Finally, conceptualizing the incentives and motivations of VCs to make investments in the CE helps to understand better what role can be expected from these investors in the CE transition. Due to their focus on investing in start-ups which can play a crucial role in a transition, they have a promising potential to be an important player in this transition. However, their actual role has yet to be examined in greater detail in the literature which makes the results of this thesis a great contribution to this field of research. Furthermore, the practical implications are especially given for policymakers as they gain a further understanding of how much they can rely on VCs to contribute to a transition toward a desired direction.

The remainder of the paper is structured as follows: Section 1 reviews the existing literature on the role of finance in transitions, highlighting the thesis's contribution to this research field and providing an overview of the current state of research. Section 2 introduces the relevant theory for this thesis, including the Multi-Level Perspective (MLP), which serves as a framework for analyzing the dynamics of the Circular Economy (CE) transition, along with conceptualizations of the circular economy, circular economy business models (CEBM), and design strategies. In Section 3, the methods used in this thesis are presented. A content analysis is employed to address RQ1.1 and RQ1.2, while semi-structured interviews are conducted to answer RQ2.1 and RQ2.2. Section 4 presents the results, starting with the findings of the content analysis, followed by those of the semi-structured interviews. A discussion of the results is included in Section 5, with separate discussions for RQ1.1 and RQ1.2 and then for RQ2.1 and RQ2.2. Finally, Section 6 concludes by answering the research questions, providing final remarks, offering recommendations for future research, and acknowledging the limitations of this thesis.

1. Literature review

The role of finance in the circularity and sustainability transitions

In this section, the existing literature on the role of finance in the circularity transition is reviewed. The literature on the role of finance in the transition to a CE is very limited, and only one published article that directly delved into this field of research was found in the course of

this study (de la Cuesta-González & Morales-García, 2022). However, since the ultimate goal of the CE is often defined as achieving sustainable development (Kirchherr et al., 2017), this study uses sustainable transition literature as an analytical framework to understand the dynamics of the transition to a CE (de la Cuesta-González & Morales-García, 2022).

To analyze the circularity transition this thesis uses the multi-level perspective (MLP) as a theoretical foundation. The MLP views system changes from three analytical levels. On the niche level, radical innovations are developed by smaller actors like sustainable entrepreneurs (Geels, 2011). The regime represents the current dominant system and consists of actors and rules that reproduce the existing socio-technological structures. Therefore, changes on the regime level are usually rather incremental and follow specific trajectories that stabilize the system (Geels, 2011). The regime and niches are embedded in the landscape level, that in a broader context defines conditions and trends that influence the two respective other levels. By doing so, the landscape can put the regime under pressure and open a window for a radical change emerging form the niche (Geels, 2010; Hörisch, 2018). A further elaboration of the concept is presented in the theoretical framework.

In sustainability literature, studies that investigate the role of finance in the sustainability transition are also limited. However recently, scholars have become increasingly interested in the topic (Naidoo, 2020; Nykvist & Maltais, 2022). It has been acknowledged that finance can influence certain technological trajectories and innovation pathways by privileging certain levels of risk and technology areas (Mazzucato & Semieniuk, 2018). For example, Scholtens (2006) argues that on a micro level, finance can influence a firm's operations by deciding what is being financed and what is not. Collectively, this aggregation of efforts can steer economic development, and given the growing interest of financial actors in sustainability, they have the potential to significantly impact sustainable development at an economic level (Scholtens, 2006). Considering that sunk investments and path dependencies are seen as main barriers to a radical transition (Geels, 2010), investigating the dynamics of finance in the transition becomes an interesting field of research. By analyzing what is being financed in the CE, this study will contribute to this field and provide insights regarding the current transitional pathways finance supports.

The existing literature discussing the role of finance in the MLP usually positions finance on the regime level (Geels, 2013). Geddes & Schmidt (2020) even argue that finance is its own regime which constitutes its own actors and institutions, set of norms, rules and heuristics, as

well as organizational and cognitive routines. Moreover, they emphasize that finance has a selection function and can decide which niche actors and technologies enter the regime, making it the center of innovation that affects all other socio-technical regimes. With respect to the niche-regime interaction the authors conclude that to steer capital towards niche technologies, either the niche must fit and conform to the requirements of the financial system or the financial regime is stretched and transformed so that it accepts the niche technologies (Geddes & Schmidt, 2020).

Nykvist & Maltais (2022) support this argumentation. Similar to this thesis, the authors investigated the incentives and motivations of bigger financial actors to invest in sustainability-related investments. They found that those actors are primarily interested in making risk-adjusted returns rather than achieving sustainable change (2022). This limits their role in the transition as they are not expected to actively foster the change as long as sustainable investments are not financially more attractive than conventional ones. However, the authors only focused on bigger investors who invest in companies and technologies that have already reached the commercialization stage (Nykvist & Maltais, 2022).

Though, for a successful transition to happen, it needs a finance mix of different types of finance that match the requirements of the development stage of a technology (Polzin, 2017). Therefore, this thesis aims to extend and critically examine this field of literature by investigating the role of VCs in the circularity transition. This is relevant since VCs invest in start-ups which, as niche actors, can play a crucial role in the transition (Hörisch, 2015). As all the investigated VCs have invested in some type of circular start-up, this study tries to determine to what extend they represent system builders (Gibbs & O'Neill, 2014) or if these financial actors view the CE as an investment opportunity. Furthermore, looking into what is being financed by bigger investors will provide impactful insights regarding whether they financially support incumbents that stabilize the current system or whether their funds can play a more significant role in the transition by supporting rather radical circularity practices.

The conventional standards and paradigms of finance, which mainly follow the goal of achieving risk-adjusted returns, have been identified by several authors as a barrier for finance to become an active player that is driving the transition (Mazzucato, 2013; Naidoo, 2020; Seyfang & Gilbert-Squires, 2019). Naidoo (2020) critically reviewed the existing finance literature and found that even though current debates and discussions in the field are critical, they are still focused on the principles of orthodox finance. Hence, these principles are

predominantly influencing the sustainability transition. As finance is still mostly focusing on quantitative criteria (like profit maximization), she argues it needs more qualitative finance, which entails a shared understanding of a sustainability transition with the ultimate goal to create a new economic system that includes environmental and social aspects (Naidoo, 2020).

Mazzucato (2013) follows a similar argumentation and remarks that the uncertain nature of innovations, which are crucial for the transition, is not attractive for financial actors assessing investments based on risks. Therefore, with the current market conditions, finance is rather penalizing innovative firms instead of supporting them. Hence, she emphasizes the need for a financial system that focuses on creating value in the economy instead of exploiting it. Finally, she also concludes that it needs new mechanisms for finance that acknowledge 'good' risks and support the development of new technology (Mazzucato, 2013).

The role of finance in the innovation process has already been emphasized by Schumpeter (1934), who identified finance as an essential player of the innovative performance of an economy. However, he only focused on banks as capital providers in an economy. Polzin (2017) took a more holistic approach and investigated the typical innovation cycle of a technology. He argues that along this cycle, different barriers occur, which are considered as risks by investors. Moreover, depending on their type, investors have a different willingness to accept risks. Therefore, for a successful transition, the type of investor and their risk profile must match the technology requirements in the respective development stage.

Consequently, it requires a finance mix that is specifically appropriate for the needs of a transition (Polzin, 2017; Polzin et al., 2021; Polzin & Sanders, 2020). Figure 1 summarizes the different innovation stages, barriers, and matching types of investors. This emphasizes the need to focus not only on one type of investor in a transition but on different actors who can fulfill different roles.

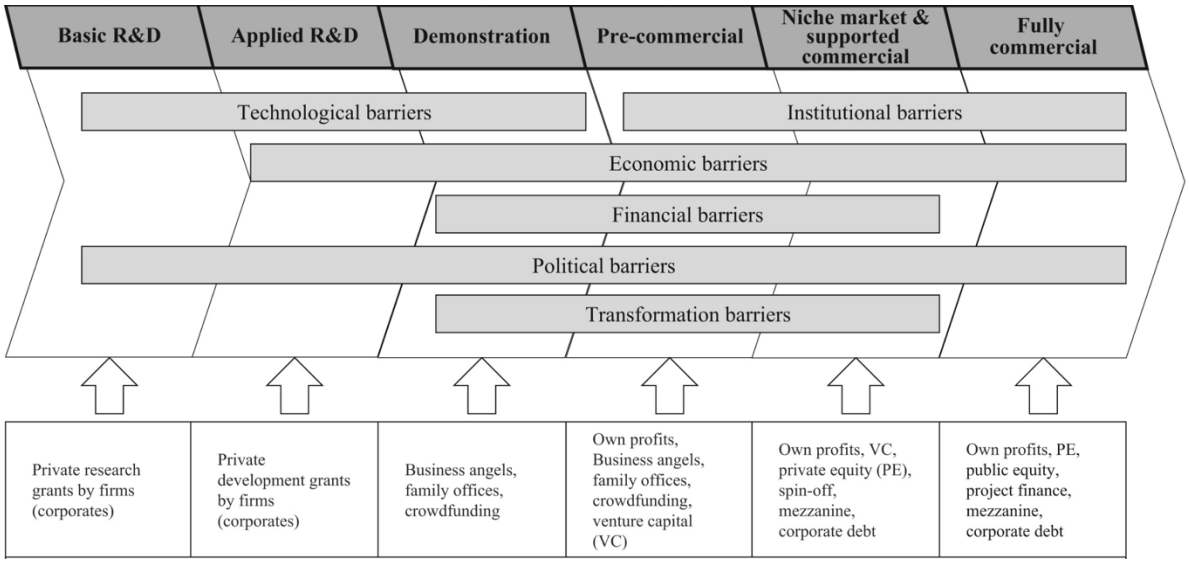


Figure 1 Private finance according to the development stage of a technology including implementation barriers adopted from Polzin (2017)

The CE and finance

Even though the literature on finance in the circularity transition is very limited, there are some articles that contribute to a better understanding of what role finance can play in the transformation from a linear to a circular system.

Generally speaking, a lack of finance was identified as a main barrier for businesses to implement circular practices (Rizos et al., 2016; Tura et al., 2019; Vermunt et al., 2019). Likewise, it was found that a higher level of investment also means a higher level of circularity in a company (Aranda-Usón et al., 2019). Consequently, it can be stated that finance plays a major role in the transition to a CE, however, more financial resources are needed to exploit this potential (Aranda-Usón et al., 2019).

According to the study by de la Cuesta-González & Morales-García (2022), finance is currently not yet ready to take over this role. This is primarily because the implementation of CE practices bears specific uncertainties and barriers which are associated with risks by financial actors. Moreover, since finance is still using conventional assessment criteria to evaluate firms, the CEBM are often misunderstood and analyzed as being too risky to invest in. Hence, they conclude that the current financial practices are not eligible to make finance a driver of the CE transition and it needs novel assessment criteria that better reflects the benefits of CEBM (de la Cuesta-González & Morales-García, 2022; Gonçalves et al., 2022).

Publications that discuss such types of circular assessment criteria in more detail can be found in the grey literature (e.g., Achterberg, 2021; Circle Economy, 2022; Potting et al.,

2017). The paper by Circle Economy (2022), for example, argues that it needs new accounting schemes that redefine impact, value and risk when assessing CEBM.

Finally, the literature review has shown that the role of finance in transition studies is rather embryotic. The dominant opinion is that even though there is a shift towards more sustainability related topics, finance is still mostly focused on achieving risk-adjusted returns which influences their investment decision. According to Geddes & Schmidt (2020) one reason for the limited availability of research in the field is because researchers in the past assumed that markets are fully rational and no interventions are needed to steer finance in a desired direction. Such assumptions are based on the efficient market hypothesis which states that financial markets efficiently allocate capital by pricing risk and return expectations perfectly through fully reflecting all available information (Malkiel & Fama, 1970). Whether an investor invests or not depends then on their willingness to take a certain risk in relation to the expected returns. Hence, it is argued that investors are technology neutral and invest based on the risk adjusted returns they can generate (Geddes & Schmidt, 2020).

Contradictory, evidence illustrates that financial markets are path depended and not technology neutral which emphasizes the need to investigate what is currently being financed to better understand the trajectory of a transition (Geddes & Schmidt, 2020).

Moreover, the literature emphasized the need of finance in the innovation process and the development of novel radical technologies. It is argued that a transition requires, what Perez (2003) refers to as 'courageous and bold' finance. Especially when finance is too attached to established markets and incumbents. VCs which are investing in start-ups that have not yet reached the commercialization stage are known to be rather risk-taking investors and could fit in this picture (Moore & Wüstenhagen, 2004). Thus, this study examines to what extend VCs are able to foster the circularity transition.

2. Theoretical Framework

2.1 The multi-level perspective (MLP)

The transition towards a circular system involves transforming existing structures and well-established processes in the dominant linear system. Hence, when talking about a transition to CE, scholars often think in socio-technical systems to with cope these complex, multi-level, and multi-dimensional processes and take a holistic point of view (de la Cuesta-González & Morales-García, 2022; Diaz Lopez et al., 2019; Henry et al., 2020; Kevin van Langen et al., 2021;

Reike et al., 2018). Such systems comprise the co-evolution of social and technical elements like different actors and institutions but also material artifacts and knowledge that interact and dependent on each other. Therefore, socio-technical changes do not only entail technological innovations but also changes in markets, user practices, policy, and cultural meanings (Geels, 2010).

As aforementioned, in this thesis, the multi-level perspective will serve as the analytical framework to understand the multi-dimensional complexity of the circularity transition (Geels, 2010). The concept distinguishes three analytical levels, namely niches, regimes, and landscapes, and argues that a transition derives from interactions between processes within these levels (Geels, 2010; Geels & Schot, 2007).

The socio-technical regime describes the established system where radical changes are most difficult to realize. This is because of the existing structures among the actors and institutions of the regime. It is argued that their alignment of activities influences their behavior along predictable trajectories that stabilize the system. As a consequence, due to lock-ins like sunk investments, novelties are usually introduced along certain path-dependencies and are thus rather incremental than radical (Geels, 2010, 2011).

Contrastingly, radical changes usually develop in niches without being pressured by the regime's structures (Geels, 2010). Innovations that are developed in socio-technical niches mostly underperform. However, under certain circumstances, they can gain momentum and compete against the regime resulting in a transition to a new socio-technical system (Geels, 2011). These circumstances are usually provided by the socio-technical landscape, which is referred to as the societal context in which the regime and niches are embedded on a macro-level. Landscape processes include, for example, environmental and demographic change, new social movements, shifts in general political ideology, or cultural developments, and they are able to create pressure on the regime to open a window for change (Geels, 2010; Smith et al., 2010).

The focus of analysis in this thesis concerns the transition to a CE. However, literature that examines this transition from a MLP is somewhat limited in contrast to the more extensive literature on sustainability transitions. Since in this study, the ultimate goal of a CE is considered to achieve a SD (Kirchherr et al., 2017), sustainable transition literature will be used as an analytical framework to understand the dynamics of the CE transition (Geddes & Schmidt, 2020). However, this bears some limitations. For instance, scholars have questioned

whether the principles of a CE can bring the needed system change towards SD (Pel & Achten, 2022). Moreover, it is often stated, that the CE as an economic concept succeeds in being beneficial for economic actors and the environment, but it only implicitly considers the social dimension of SD (Geissdoerfer et al., 2017).

2.1.1 Characteristics of a circularity transition

The MLP was chosen as a framework to analyze the transition to a CE as it reflects the multi-dimensionality of a transition by considering the three different levels and how they interact with each other. However, to discuss the role of financial actors in the transition it needs clarification of further characteristics of a transition to cope with the complexity of the MLP. Therefore, in the following section, typical stages a company is going through in a CE transition, in addition to three pathways such a transition can take, are presented.

Even though transitions in the light of the MLP are usually described as non-linear and iterative learning processes (Geels, 2011), some authors have identified specific phases a transition can typically undergo (e.g., Loorbach & Wijsman, 2013). On a firm level, Chen et al. (2020) developed a framework that conceptualizes three different stages a company can be situated in within the transition from a linear to a circular business model (BM).

In the first stage, a company has not yet implemented any circular solutions and the main task is acknowledging the problems of the current linear system and turning them into possible opportunities and solutions. This entails understanding the CE concept and its benefits for the own firm. In the second stage, the company evaluates the solutions of the first stage according to the feasibility, circularity, or commercial value they promise. Moreover, practices can be implemented on a smaller scale, like in pilot projects. In the last stage, a dominant solution has been implemented, and the company must now develop ways to evaluate its performance (Chen et al., 2020).

Gaining an understanding of the current stage in the transition of companies financed by investors will provide valuable insights into the key factors that influence the investors' investment decisions. This can be essential for assessing the investors' role in the transition process. For example, it can be argued that the CE is still in the pre-development stage of the transition (Kevin van Langen et al., 2021). If the results show that the investors mainly invest in companies that are very advanced in the transition, they would be ahead of the general transition process, impacting the classification of their role in the transition.

Table 1

CEBM transition framework according to Chen et al. (2020)

Stage	Characteristics
Stage 1	Acknowledging the problems of the linear economy and understanding the benefits of the CE
Stage 2	Evaluating solutions and implementing them on a smaller scale
Stage 3	Implementing solutions and evaluating their performance

Besides the different stages of the classification of transitions, the literature provides several pathways a transition can take (Geels & Schot, 2007; Hörisch, 2018; Loorbach & Wijsman, 2013). Evidently, a transition will not always result in a radical change where the existing regime is replaced by a new dominant system emerging from the niche. Moreover, especially from a circularity perspective, a transition can also end in a rather undesirable state, where the required changes are not sufficiently achieved (Loorbach & Wijsman, 2013). Therefore, it is essential to pay attention to the pathway a transition is currently taking to understand better whether it results in a desired state or not. Following Hörisch (2018) and Loorbach & Wijsman (2013), the three pathways transformation, optimization, and reconfiguration are used in this thesis to understand which of them is supported by the financial actors under investigation.

If a transition follows the transformative pathway, the existing regime is comprehensively replaced by a new regime emerging from the niche (Hörisch, 2018). The optimization pathway is characterized by incumbents adopting practices from the niche to lower the landscape pressure. Hence, instead of a regime replacement taking place, the stability of the regime is increased. Lastly, during the reconfiguration pathway, incumbents pick-up innovations from the niche and implement them as additional practices and/or products. However, the conventional practices remain, and no comprehensive regime replacement occurs (Hörisch, 2018).

Table 2

Transition pathways according to Hörisch (2020) & Loorbach & Wijsman (2018)

Pathway	Description
Transformation	Comprehensive replacement of the existing regime
Optimization	No replacement but stabilization of the existing regime
Reconfiguration	Adoption and incremental change of the existing regime

2.1.2 Actors in transitions

A common criticism of the MLP is that actors and agency are not sufficiently considered in the concept (Fischer & Newig, 2016; Geels, 2011; Geels & Schot, 2007). There is a diverse range of actors that can influence a transition and their behavior is complex. Therefore, understanding those actors is vital to determine how they are engaged in the transition and which pathways they support (Fischer & Newig, 2016). For example, whether an actor is outside or inside of the regime can significantly influence its role in the transition, as regime actors are usually rather resistant to radical change (Fischer & Newig, 2016). Hence, they are less likely to support a transformative pathway in a transition.

On the other hand, start-ups and entrepreneurs, which are often known for being situated at the niche level, might as well be regime actors if they are, for instance, developing new technologies that support the regime and stabilize its position (Gibbs & O'Neill, 2014; Hörisch, 2015). Moreover, some start-ups even apply a 'small is beautiful' approach by not being interested in challenging the current regime and offering products outside their niche. This especially applies to green start-ups which follow a rather idealistic approach instead of a commercial one (Hörisch, 2015).

Thus, understanding certain actors' interests and power can provide interesting insights into their ability to influence a transition. As the literature review has shown, finance can play a crucial role in the circularity transition as such a socio-technical change requires the re-direction of capital away from the current linear system towards more circular practices and technologies (Geddes & Schmidt, 2020). Furthermore, within this transition, companies were identified as central contributors as they have the innovative capabilities to create new circular solutions to drive toward a CE (Henry et al., 2020). Therefore, finance can be considered as a provider of the resource capital for firms to innovate in the field of the CE (Aranda-Usón et al., 2019; Mazzucato, 2013).

Broadly speaking, companies can choose amongst three types of finance: internal equity finance (equity from owners or generated earnings), external debt finance (e.g., equity provided by a bank), or external equity finance (e.g., equity acquisition through selling company shares). This thesis focuses on financial actors that provide external equity finance, as especially young companies often have difficulties accessing internal equity or external debt finance (Müller & Zimmermann, 2009). Additionally, two crucial aspects in a transition are the suitable type of finance that companies receive based on their stage of development and the

specific elements being financed.(Mazzucato & Semieniuk, 2018; Polzin, 2017; Polzin et al., 2021; Polzin & Sanders, 2020). This highlights the importance of exploring various types of financial actors. Consequently, this thesis delves into VCs as providers of private equity and larger investment funds that offer public equity.

Furthermore, beyond the financial actors themselves, the companies they invest in also hold a crucial role in this thesis. Examining the role of different business actors by size builds on the work of Hockerts & Wüstenhagen (2010), who conceptualized how start-ups and incumbents engage in such a transition. The authors argue that in a sustainability transition, both actors are crucial participants, and it needs their interaction for a successful transformation. The role of the emerging start-ups (referred to as 'Davids') is the development of novel disruptive innovations outside the dominant technological mindset to challenge the incumbents. From a multi-level perspective, they can be seen as niche actors developing radical innovations that potentially contribute to a shift to a new regime.

How start-ups can contribute to a transition has been illustrated in previous studies in the literature (Gibbs & O'Neill, 2014; Hörisch, 2015). However, Hörisch (2015) argues that start-ups alone usually cannot push their novelties into the regime, and they need the support of additional actors. Furthermore, Gibbs & O'Neil (2014) emphasize the need to investigate start-ups in a broader network of actors involved in the shift to a new economic system. In this study, VCs are considered as a part of this network, potentially having the ability to support start-ups bringing their circular innovations from the niche into the regime.

Incumbents (referred to as 'Goliaths'), on the other hand, tend to be less disruptive when it comes to the implementation of novel practices due to their existing assets and business-as-usual thinking (Hockerts & Wüstenhagen, 2010). However, if they are engaged in the transition, they can be crucial participants in the transformation as they have access to the mass market. Their strength lies in process innovation, and when seriously pressured and challenged by the emerging start-ups and their innovations, incumbents are able to pick up and adopted to these innovations. They often do this in an even more professional way due to their access to relevant resources like capital or professional investors such as the investigated funds in this study (Hockerts & Wüstenhagen, 2010).

2.2 The circular economy

The fact that the CE has derived from different schools of thoughts and theories and that various stakeholders with different interests have contributed to the development of the concept has resulted in undefined boundaries and no commonly accepted definition of a CE. To assess the circularity performance of companies, it is, however, important to first agree on a definition of what a CE encompasses. In the study of Kircherr et al. (2017), the authors reviewed 114 definitions of peer-reviewed articles, policy papers, and consultancy reports and developed based on their findings, the following definition of a CE:

"A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations" (Kirchherr et al., 2017, p. 224).

This definition was chosen for several reasons. First, it puts sustainable development at the center of the concept as it is defined as the overreaching goal of a CE. This is considered a crucial aspect because the lack of conceptualization of the CE has resulted in different understandings of the concept with each understanding having their own focal point. For example, Reike et al. (2018) critically remark that some actors view the CE as a paradigm for growth while neglecting the potential to modify the current system towards more sustainability. Likewise, Hofmann (2019) argues that implementing CEBM in companies is often too embedded in the contemporary neo-liberal paradigms of creating value for shareholders. Therefore, if the sustainability aspect is not sufficiently considered in the conceptualization of the CE, there is a risk that a transition to a CE would lead to new growth potentials for economies and firms but not address the current ecological and social issues.

Second, the definition emphasizes the importance of circular economy business models (CEBM). This aligns with this thesis, where CEBMs are identified as an ideal concept to evaluate what is being financed by the respective investors to understand their role in the CE transition. On a firm level, CEBMs are considered key drivers for the CE transition mainly because they go beyond other sustainability concepts like industrial ecology, where the focus

is on the implementation of measures (Bocken et al., 2016; Chen et al., 2020; de la Cuesta-González & Morales-García, 2022; Hofmann, 2019; Palmié et al., 2021; Ranta et al., 2018; Reike et al., 2018; Salvador et al., 2020). Instead, CEBMs focus on the implementation of the concept on an organizational level (Reike et al., 2018). Therefore, including CEBM in defining a CE highlights the importance of those BMs and legitimizes them as a framework later in this paper.

Third, the definition includes different stages of the R-ladder (reducing, reusing, recycling, and recovering), which are considered essential operationalization principles of the CE (Reike et al., 2018) and which will also be used as an analytical framework later in this thesis.

Lastly, by acknowledging that the CE affects the micro, meso, and macro level, the definition takes a systematic view of the concept, which supports the idea of this study that the implementation of the CE requires a change on a system level and justifies its investigation through the lens of the MLP.

In summary, the definition of the CE is considered as a perfect match for this thesis because it encompasses key concepts that will be utilized to examine the transition to a CE and consequently adds credibility to their application.

2.2.1 The two cycles of the CE and the R-ladder

Besides this general definition, there are two other concepts which are related to the CE that will play a role in this thesis. These are the biological and technical cycle as well as the R-ladder. Elaborating on both of these concepts will contribute to a better understanding of the CE and serve as a foundation for the theoretical framework of the rest of the paper.

One of the central ideas of a CE is that resources, materials, or products circulate in loops which contradicts the current linear system and aims to replace the end-of-life concept (Bocken, 2015). In their cradle-to-cradle concept Braungart and McDonough (2002) set the foundation of this idea. The authors argue that materials should circulate in biological or technical loops to ensure a fully circular system.

The biological circle was developed for products of consumption and requires a product design consisting of materials that are completely biodegradable. This is supposed to ensure that the materials of a product can be brought back into the environment while and after it is being used without causing any harm and even providing nutrients for new materials.

The technical cycle, on the other hand, is designed for products that contain materials that are not biodegradable. Their design should ensure that materials circulate in closed loops

without contaminating the environment. Different strategies to close these loops are possible, for instance, repairing or remanufacturing, all aiming to design long-life products or life cycle extensions (McDonough & Braungart, 2002). The distinction between these two cycles has been adopted by different other concepts like the butterfly diagram of the Ellen MacArthur Foundation (EMF) (2013) (see Fig.2) that contains different approaches to close the loops within the two cycles (Markard et al., 2012).

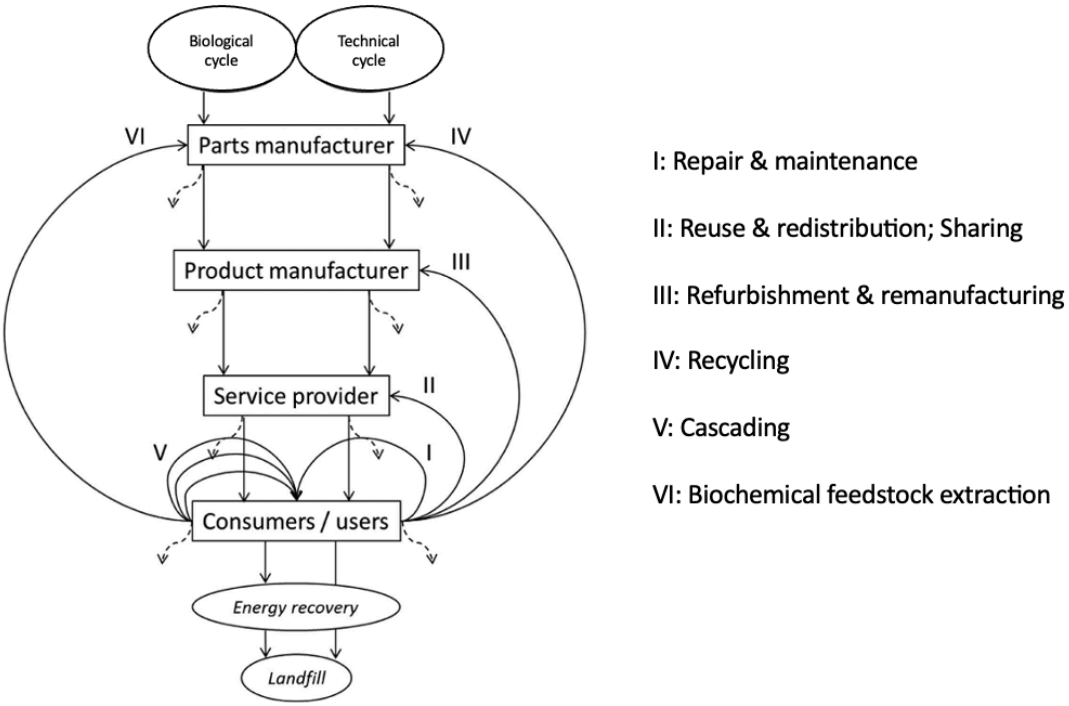


Figure 2 Major reverse cycles of the CE adopted from Lüdeke-Freund et al. (2019) and based on EMF (2013)

These approaches are also referred to as R-imperatives which describe measures to keep products or materials in the circular system. A literature review conducted by Reike et al. (2018) found that these R-imperatives are conceptualized quite differently by various authors, with concepts including between 3 to 10 Rs. In this thesis, a conceptualization by Potting et al. (2017), including 9 Rs is used as a theoretical framework. The concept was chosen as it includes a high number of Rs which promises a comprehensive and nuanced overview of the R-imperatives implemented in the analyzed companies (Kirchherr et al., 2017).

The concept was complemented by two additional imperatives, namely ‘sharing’ and ‘cascading’. Even though they do not start with the prefix ‘re-‘, they contribute to the circulation of materials/products in a system. Moreover, both are part of the conceptualization of a CE through the butterfly diagram by the EMF (Ellen MacArthur Foundation, 2013).

Sharing, in this case, refers to practices where the owner of a product provides its services to customers instead of selling its ownership[1]. Therefore, the product owner is incentivized to keep the product in a good condition to use it as long as possible (Tukker, 2015). The imperative could also be assigned to 'rethinking' as through sharing, products are used more intensively. However, according to Pötting et al. (2017) 'rethink' is defined rather generic and could also comprise other practices like multi-functional products. Therefore, acknowledging that sharing practices are deemed vital for the CE transition in the literature (Henry et al., 2020), it was included as a distinct imperative between 'reduce' and 'rethink' to provide a more apparent distinction to the 'rethink' imperative.

Conversely, cascading refers to "taking and winning back the biological nutrients contained in product components, used materials, and waste" (Lüdeke-Freund et al., 2019, p. 51). It was added to the concept as it represents a practice of the biological cycle, which are otherwise barely represented in the framework. Furthermore, since cascading is a useful application of materials, it was added between recycling and repurposing.

Even though there are different R-imperative approaches, most of them have in common that they put the various Rs in a hierarchy. This means that the highest R (in this case, refuse) is expected to bring the greatest circularity and sustainability effects as the original product remains close to its user and function (Reike et al., 2018). Eventually, this usually means that fewer raw materials are needed in the product production which reduces the environmental pressure (Potting et al., 2017). Going down the hierarchy, the resource loops are getting longer, and products lose their original purpose and serve, for example, as a source of materials in the production of new products. For instance, a product that is being repaired (the fourth R in the hierarchy) only undergoes relatively small adjustments, while for remanufacturing measure (sixth R in the hierarchy), the product is disassembled and loses its intended purpose. The bottom Rs, like recycling and (energy) recover, are rather seen as an "upgrade to landfill management" and are commonly determined as least desirable (Reike et al., 2018, p. 256). Due to the hierarchal structure, the R-imperatives are often referred to as the R-ladder. An overview of the R-ladder framework used in this thesis is presented in Figure.3.

[1] Note that term 'sharing' in this cases refers to the sequential use of a product by different customers (Tukker, 2015). However, it does not refer to the 'sharing economy' which is a separate economic system. Even though, the sharing economy is overlapping the CE in some points, the two concept should not be mixed up. For a more detailed distinction between the two concepts see for example (Henry et al., 2021)

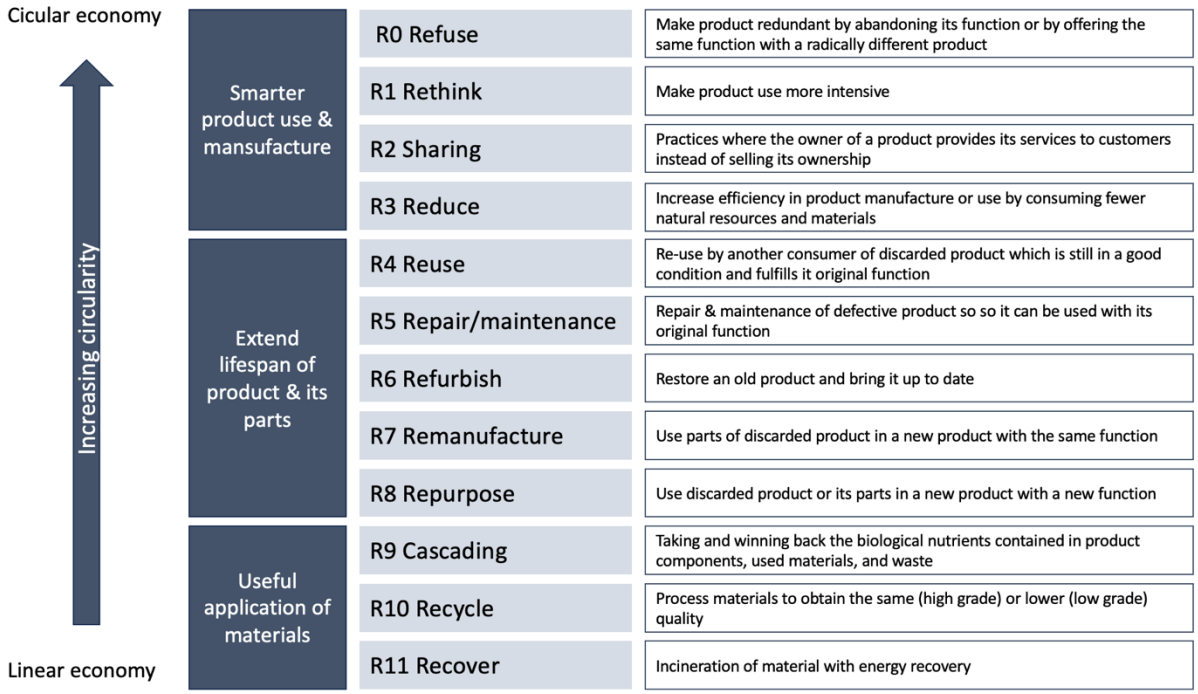


Figure 3 *Framework of the R-ladder adopted from Pötting et al. (2017) and Kirchherr et al. (2017)*

2.2.2 Circular Economy Business Models and design strategies

To analyze what is currently being financed in the CE transition and especially with regards to RQ1.1 and RQ1.2, in this thesis, circular economy business models (CEBM) serve as an analytical framework. CEBM have been identified by several authors as a key driver for the CE transition and are therefore considered as an ideal concept to gain insights about what is being financed by the investors (Bocken et al., 2016; Chen et al., 2020; de la Cuesta-González & Morales-García, 2022; Hofmann, 2019; Palmié et al., 2021; Ranta et al., 2018; Reike et al., 2018; Salvador et al., 2020). Hence, in the following section, the relevance of CEBM for the CE transition is first elaborated upon and then conceptualized into a CEBM framework.

While a transition is considered as a systematic and socio-technical change that includes reconfigurations on different levels (e.g., infrastructure or cultural meaning), businesses are seen as central actors who are able to contribute to or resist such change (Chen et al., 2020; Geels, 2011). The implementation of CE practices in a firm is usually referred to as changes on the micro-level (Barreiro-Gen & Lozano, 2020), and scholars have identified business models (BM) as central concepts to achieve systematic change on a firm level (Hofmann, 2019). "*Business models have been ascribed the potential to disrupt entire industries, because they connect multiple actors, mediate between the production and the consumption side of business and support the introduction of novel technologies into the market*" (Bidmon & Knab, 2018, p. 903).

Generally speaking a BM describes the value creation strategy of a company (Salvador et al., 2020) and comprises three elements which are value proposition, value creation and delivery as well as value capture (Richardson, 2008; Salvador et al., 2020). Hence, a BM describes how a company does business (Magretta, 2002) and "i*s concerned with how the firm defines its competitive strategy through the design of the product or service it offers to its market, how it charges for it and what it costs to produce. How it differentiates itself from other firms by the nature of its value proposition. It also describes how the firm integrates its own value chain with that of other firms in the industry's value networks*" (Rasmussen, 2007, p. 1).

However, BMs are traditionally based on the take-make-dispose patterns of the linear economy which the practices of a CE must replace for a circularity transition to happen (Hofmann, 2019; Salvador et al., 2020). A CEBM requires changes in the value proposition, creation, and delivery by using resources in multiple cycles and reducing waste and consumption (Lüdeke-Freund et al., 2019). Depending on the type of CEBM, such changes can be either rather incremental or radical and sometimes require a rethinking of the classical consumer-producer relationship (Diaz Lopez et al., 2019; Hofmann, 2019).

The concept of CEBM will be mainly applied to RQ1.1 to understand what is currently being financed by public equity funds. Those funds are expected to invest in incumbent companies due to their risk aversion (Nykvist & Maltais, 2022; Polzin, 2017). However, incumbents are usually known for being rather resistant to radical changes (Geels, 2010) and therefore, it is questionable to what extent they will have actually implemented CEBM. Hence, the analytical framework to answer RQ.1.1 will include not only a conceptualization of CEBM but also circular design strategies. Circular design strategies do not necessarily require changes on the entire company level but comprise product innovations (Lüdeke-Freund et al., 2019). Nevertheless, they play an essential role since, with the implementation of a CE, the requirements a product must fulfill can change, for example, with respect to its lifetime (Moreno et al., 2016).

2.2.3 Conceptualization of CEBM and design strategies

This section defines the circular design and CEBM strategies, which are used later in this study to analyze what is being financed in the CE transition and hence to answer RQ.1.1. The conceptualization of the 2 frameworks is based on the existing literature.

Circular design strategies and CEBM have been conceptualized by several authors (Bocken et al., 2016; Lewandowski, 2016; Lüdeke-Freund et al., 2019; Moreno et al., 2016).

Bocken et al. (2016) developed a framework that defines three design and business model strategies according to the mechanisms resources flow through a system which comprise slowing and closing resource loops as well as narrowing resource flows. Slowing resource loops includes a time dimension of how materials flow through a system. It refers to prolonging the use and reuse of products by either designing long-life goods or offering services that extend their life. Thus, these strategies belong to the technical cycle. Closing loops refers to the recycling of materials and does not include the extension of a product's life and, thus, no time dimension. Finally, narrowing resource flows is about using fewer materials associated with product and production processes and can be understood as the implementation of resource efficiencies (Bocken et al., 2016). This framework will serve as a foundation for the further conceptualization. Thus, the circular design and BM concepts will be categorized according to the three strategies.

For the definition of the circular design strategies Bocken et al's. (2016) framework was evaluated as the most suitable for this study. They provide a taxonomy of 9 design approaches that contribute to the implementation of a CE and that are categorized according to the slowing and closing of resource loops. The authors excluded the narrowing of resource flows since measures that fall under this category are usually efficiency approaches that do not address the circulation of goods. Thus, these approaches can still lead to an overall increase in resource consumption when more efficient products are consumed (Bocken et al., 2016). However, this thesis aims to investigate which circularity practices are being financed to draw conclusions on the investors' role in the CE transition. Therefore, circular design strategies contributing to the narrowing of resource flows were added to Bocken et al's (2016) list. This is because there is no information available yet on what the respective investors and the companies they invest in understand under the CE concept. Hence, excluding those strategies could limit the results of this thesis as investors may perceive those strategies as circular, which would not be captured by the framework if they were not included.

Consequently, narrowing measures associated with resource reduction in the production process were added to Bocken et al's (2016) list of circular design strategies. These approaches are based on the taxonomy of Moreno et al. (2016), which was also used to define the specific design strategies by Bocken et al. (2016). An overview of circular design strategies considered in this study can be found in Table 3, while a more detailed conceptualization is presented in Appendix I.

Table 3

CE design strategy framework

Design strategy	Categorization
Slowing loops	
Designing long life products	Design for attachment and trust
	Design for reliability and durability
Design for product-life extension	Design for ease of maintenance and repair
	Design for upgradability and adaptability
	Design for standardization and compatibility
	Design for dis- and reassembly
Closing loops	
Design for a technological cycle	
Design for a biological cycle	
Design for dis- and reassembly	
Narrowing resource flows	
Design for reducing resource consumption	Design for reduction of production steps
	Design for light weighting, miniaturizing
	Design for eliminating yield loses/material/resources/parts/packaging
	Design for reducing material/resource use

While the implementation of circular design approaches on a product level is an important step towards more circularity in a company, as argued before, it requires further actions on a strategic level for an actual transition. Hence, several authors have conceptualized CEBM archetypes in literature (Bocken et al., 2016; Lewandowski, 2016; Lüdeke-Freund et al., 2019). While Lewandowski's (2016) approach based on the ReSOLVE framework probably provides the most comprehensive overview in this space, in his concept, not all of the typologies are based on the value creation aspect of a BM (Moreno et al., 2016).

Lüdeke-Freund et al's. (2018) work on CEBM patterns is based on six reverse cycles of a CE but does not explicitly consider product service systems (PSS) which several authors consider as a crucial CEBM in the CE transition (Henry et al., 2020; Hofmann, 2019; Salvador et al., 2020; Stumpf et al., 2021).

Therefore, for this thesis, the typology of business model strategies by Bocken et al. (2016) will serve as the underlying framework for the following analysis. The authors categorized six business model strategies according to the slowing and closing of resource loops.

However, the concept rather focuses on CEBM that are related to the technological cycle. To have a more comprehensive framework that also contains BMs that create value through practices of the biological cycle, a seventh CEBM strategy was added. The 'biological business models' category contains the CEBM typologies 'cascading business models' and 'organic feedstock business models' (Lüdeke-Freund et al., 2019) as well as 'energy recovery business models' (Lewandowski, 2016).

Furthermore, as the six CEBM strategies by Bocken et al. (2016) were assessed as quite generic, the CEBM by Lüdeke-Freund et al. (2018) were assigned as sub-categories to the six strategies. For example, the CEBM strategy 'extending product value' by Bocken et al. (2016) was complemented by the CEBMs 'refurbishment & remanufacture business model' and 'reuse & redistributing business model' by Lüdeke-Freund et al. (2018). This results in a more nuanced and detailed framework allowing a further distinction of which CE practices the particular CEBM strategies are based on. An overview of these CEBM is presented in Table 4, as well as a more detailed description in Appendix II.

The implementation of circular design and business model strategies goes hand-in-hand as CEBM is considered a key driver for circular product innovations, and at the same time, these innovations require a fitting CEBM as a go-to-market and value capturing strategy. Moreover, it is argued that the more radical the product innovation, the more in-depth changes of the traditional linear business model are needed (Bocken et al., 2016) where an increasing level up the reverse cycles of the R-ladder generally requires more fundamental changes in the production and consumption model (Bockholt et al., 2020).

Consequently, by analyzing the implementation of circular design and CBM strategies of a company with respect to this R-hierarchy one can draw conclusions about the radicality of the implemented change.

Table 4

CEBM framework

Business model strategy	Categorization
	Slowing loops
Access and performance model	Access and performance model
Extending product value	Refurbishment & remanufacture business model
	Reuse & redistributing business model
Classic long-life model	Longevity business model
	Repair & maintenance business model
Encourage sufficiency	Sufficiency business model
	Closing loops
Extending resource value	Recycling business models
Biological business models	Cascading business models
	Organic Feedstock business model
	Energy recovery business models
Industrial symbiosis	Industrial symbiosis business model

2.3 The traditional Venture capitalist fund model

For RQ2, to investigate the incentives and motivations of VCs it is important to understand how a VC fund typically works. Venture capital funds are known for investing in start-ups which is considered as a high-risk investment as these companies have not yet reached the commercialization stage (Moore & Wüstenhagen, 2004). Such funds consist of a fund manager, which is also called the general partner (GP), who is setting up the fund and the investments strategy. The GP is responsible for raising capital from other investors which are referred to as the limited partners (LP) (D. Hegeman, 2021). Those are usually pension funds, insurance companies, endowments, and wealthy private investors (Moore & Wüstenhagen, 2004). Once enough capital is acquired, the GP selects the start-ups they invest in and provides them with private equity capital in exchange for company shares as well as knowledge and expertise to help the start-up grow (D. Hegeman, 2021). After a typical time horizon of 10 years, the VC prepares the exit strategy ,for example, either through selling the venture to another company (merge & acquisition) or listing it on the stock market (Lin, 2022). In either case, the VC ideally generates a return on the VC's investment to pay back its own investors (the LP) with a profit.

3. Methodology

3.1 Method for RQ1.1 and RQ1.2

In this section, the methods used in this thesis are presented. For this, the different steps of the content analysis of RQ1.1 and RQ1.2 are first elaborated, followed by an explanation of the methods regarding RQ2.1 and RQ2.2.

To answer RQ1, what is being financed by the investment funds, a qualitative content analysis was conducted that followed a three steps approach. The entire approach is deductive as the investors of this size are considered by several authors as regime actors primarily striving for risk-adjusted returns (Geddes & Schmidt, 2020; Geels, 2013; Nykvist & Maltais, 2022). This study aims to test whether these findings apply to the CE transition by investigating if the investors follow certain patterns of behavior of regime actors and what those patterns entail.

Step 1 – conceptualization of CEBM and circular design strategies

As aforementioned, CEBM and circular design strategies were identified as appropriate frameworks to assess which circularity practices are being financed. Therefore, in a first step, the two concepts had to be conceptualized to understand what they entail. The goal was to develop a comprehensive framework of different CEBM and design strategies that reflect the R-imperatives presented in the theoretical framework. To do so, existing frameworks that conceptualize CEBM and design strategies were reviewed and compared regarding their suitability to help answer RQ1.

With respect to the design strategies, the framework developed by Bocken et al. (2016) was chosen. It not only distinguishes between slowing and closing resource loops but also incorporates a wide variety of different design strategies which represent the central R-imperatives of the R-ladder. These attributes make the framework suitable for this study as they promise to provide in-depth and detailed insights into what kind of design strategies the investigated companies have implemented. However, the framework does not include design strategies that relate to the narrowing of resource flows. As firms might have implemented those strategies as CE practices, narrowing measures conceptualized by Moreno et al. (2016) were added to the framework. The framework is presented in Table 3, and a more detailed version in Appendix I.

For the CEBM Bocken et al's. (2016) framework again served as the foundation. Moreover, in a matching approach, the CEBM patterns conceptualized by Lüdeke-Freund et al.

(2019) were assigned to the 6 CEBM presented in the framework of Bocken et al. (2016). This was done because, first, Lüdeke-Freund et al's. (2019) framework was developed based on the R-ladder, which will make it easier to allocate the identified CEBM of the investigated companies to the R-imperatives. Second, it resulted in a more detailed framework that provides greater insights into what specific CEBM are being financed. Furthermore, a seventh CEBM was added to the framework (biological business models) to include CEBMs related to the CE concept's biological cycle (McDonough & Braungart, 2002).

In the case of the CEBM, narrowing strategies were not included as they are also barely represented in the literature.

An overview of the CEBM included in this thesis by authors is presented in Tables 5-7, while Table 4 entails the resulting CEBM framework. A more detailed version of this framework, including definitions and explanations of the CEBM can be found in Appendix II.

Table 7

CEBM adopted from Bocken et al. (2016)

CEBM strategies
• Repair and maintenance business model • Reuse & Redistributing Business model • Refurbishment and Remanufacturing Business Models • Recycling Business Models • Cascading business models • Organic Feedstock business model

Table 6

CEBM adopted from Lüdeke-Freund et al. (2019)

CEBM strategies
• Access and performance model • Extending product value • Classic long-life model • Encourage sufficiency • Extending resource value • Industrial symbiosis

Table 5

CEBM adopted by Lewandowski (2016)

CEBM strategies
• Energy recovery business models

Step 2 – coding

In the second step, corporate documents and publications of the firms' the selected investors invested in were coded based on a deductive coding approach. The investment funds were sampled from a report of the Ellen MacArthur Foundation (2020), which provides a list of public equity funds with a particular investment focus on the CE. In total, five funds were analyzed, which are presented in Appendix IV. The funds were chosen because of their focus on the CE. Due to this focus, it can be assumed that they considered some kind of CE related criteria in their investment decisions. This allows to discuss which CE practices they considered as particularly attractive.

The companies that are being financed by the investors were sampled from the latest annual reports of the respective funds which are publicly accessible, and which contain a list of all the firms that that the funds invest in.

For the coding approach, the aforementioned CEBM and circular design strategy frameworks served as a coding manual (Bryman, 2012). To ensure reliability and validity during the coding process, the CEBM and design strategies were described and defined in greater detail for the coder to have a clear understanding of what to code for. The coding manual can be found in Appendix I and II. Coded were all types of documents and texts that were found on the internet and that were related to the particular companies. This included, for example, corporate websites, reports (like sustainability reports), blog entries or newspaper articles. Those documents were sampled based on a snowball sampling approach.

The coding approach was deductive, and the codes were entered in a coding schedule in Excel (Bryman, 2012). The coding schedule consists of a list of the CEBM and circular design strategies, and for each of the analyzed companies, one coding schedule was created. Therefore, it was coded for what Bryman (2012) refers to as 'subjects & themes'. If, during the coding, a CEBM or design strategy was identified based on the definition of the coding manual, it was entered in the schedule, including a description.

Moreover, a distinction was made between whether a company applied the respective CEBM or design strategy for 'all products', only 'selected products', 'by-products', or 'packaging'. By-products refer to products that are usually treated as waste but instead are given a second life through the implementation of a circularity practice. This will help to further distinguish whether a company has implemented circularity in the entire business or only for specific products.

Furthermore, it was coded for existence and not frequency. That means, if, for instance, the same CEBM was found in several corporate texts of the same company, it was coded once and not according to the frequency it occurred in the documents. However, if a company implemented different types of CEBM or design strategies, all of them were included. Finally, this process resulted in an overview of all the analyzed companies, including the CEBM and design strategies they have implemented.

Finally, once the coding process was finished, the codes were reviewed again, and each of the observed design and CEBM strategies was allocated to an R-imperative of the R-ladder.

This provides more in-depth insights on which type of circularity practices was applied within the respective design and CEBM strategies.

Step 3 – analysis of the data

Once the coding process for each company was completed and all the data was collected, a frequency analysis was performed. In doing so, the absolute amounts as well as percentages of the occurrence of each of the CEBM and design strategies were calculated. Companies that several funds invested in were only counted in once, which resulted in a sample size of 186 firms being analyzed.

The frequency analysis allows to discuss later on which circularity practices are preferred by the investors as investment targets. Moreover, the results can be compared to other studies with a similar research approach (e.g. Henry et al., 2020; Stewart & Niero, 2018).

Finally, this approach can be framed as a quantitative content analysis which "*implies a deductive approach, whereby categories are decided upon from the beginning, and unambiguous coding rules are laid out to know what goes where. [And where], statistical tools are used to analyze the results*" (Gheyle & Jacobs, 2017, p. 3).

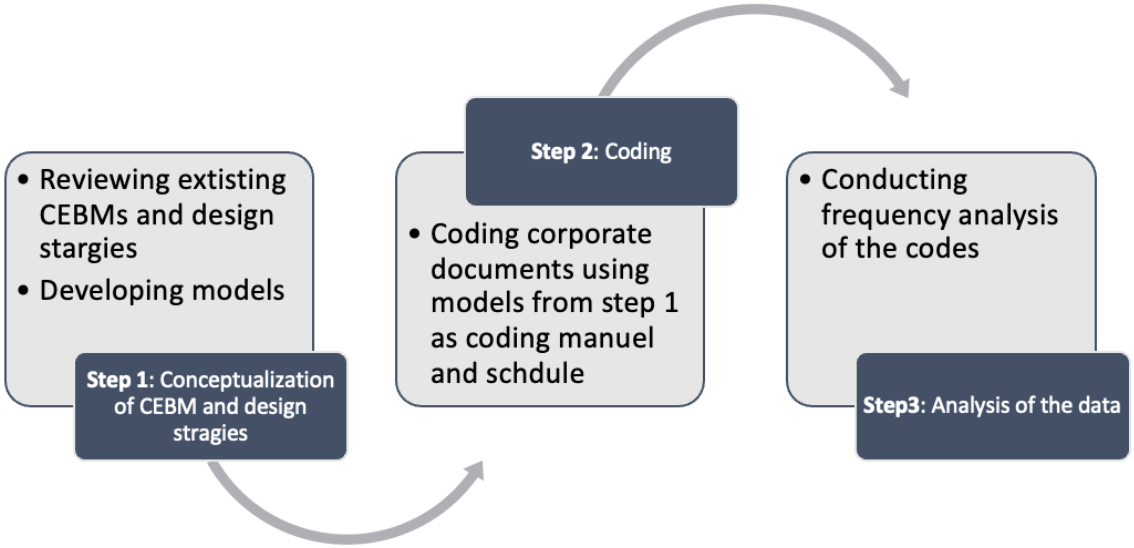


Figure 4 *Methodological approach of the content analysis*

3.2 Methods for RQ2.1 and RQ2.2

To find out about the incentives and motivations of VCs to invest in CE related business models and to answer RQ2.1 and RQ2.2 an inductive research approach based on semi-structured interviews was conducted. The inductive approach was chosen, as only limited research on why VCs make CE related investments was found. While Nykvist & Maltais (2022), followed a

similar research goal, they only investigated the role of large investors in the sustainability transition which can be allocated to the regime. However, the role of VCs in such a transition is not as clear as they invest in start-ups that can be situated in the niche but also in the regime, depending on the goal they follow and what kind of technology/solution they are offering (Hörisch, 2015).

Therefore, in this study, VCs with a circularity focus are investigated to understand the governance and incentives that drive them to actively engage in circular finance. Interviews were chosen as they provide a great degree of flexibility in the data collection, which fits with the inductive nature of this part of this thesis (Bryman, 2012).

The participants were selected through a purposive sampling approach based on a web research (Bryman, 2012). Informants were approached if they work in a VC focusing on sustainability *and* which has at least one start-up in their portfolio with a BM that can be linked to the CE. VC with no CE focus were left out as they are not actively engaged in circular finance. Moreover, the research for suitable participants has revealed that there is only a limited number of VCs with an exclusive CE focus. However, since all the interviewed VCs have at least one company with a CE related BM in their portfolio, they are able to provide insights on what motivates and incentivizes them to invest in the CE.

Finally, 12 interviews were conducted with participants that are employed in such VCs in different positions. These include eight analysts, three partners, and one fund manager. As they are engaged in the operational and strategic practices as well as the daily asset management of the VCs, they were able to provide the required information to answer RQ2.1 and RQ2.2.

The questions were created close to RQ2.1 and RQ2.2 and are based on the questions of Nykvist & Maltais (2022) to have comparable results between this thesis and their study and to increase reliability and validity. To find out about the incentives and motivations of the participating VCs to invest in the CE, the informants were asked about the goals they are following with their investments as well as why it is beneficial for them to invest in the CE. Both the goals and benefits are referred to a corporate and not a personal level. Moreover, the interview guide included questions about the barriers the VCs are currently facing when investing in the CE to gain insights on what would need to change to have more capital flowing into such investments.

Since RQ2.1 aims to find out what motivates and incentives the VCs to invest in CE related BMs, the interviewees were asked whether the CE is an interesting investment target for them, and if so, why and if any circularity practices are of particular interest for them. Furthermore, questions on their role in the transition were asked to understand how the VCs perceive their role themselves. Finally, as the literature review has shown, it is often argued that finance makes investment decisions based on the risk profile of an investment. Hence, a particular question on whether the participants perceive their investments as more risky than conventional investments was included. An overview of the interview guide can be found in Appendix III.

Coding

The interviews were recorded, transcribed, and finally coded to identify the most common patterns in the statements of the participants. The coding was conducted in NVIVO and was based on three steps.

The first round of coding was based on open coding (Corbin & Strauss, 1990). To do so, the interview transcripts were reviewed, and passages within the text were interpreted and conceptually labeled. This resulted in 176 codes.

In a second step, these codes were reviewed again using an axial coding approach (Corbin & Strauss, 1990). That means relationships and patterns within the initial codes were identified, and based on that, categories and sub-categories were built. These categories were then tested against the transcripts again to see if there are any further parts in the text that fit in the categorization.

Finally, in a last step, selective coding was conducted to create core categories (Corbin & Strauss, 1990). Through this step, six categories containing the categories and sub-categories of the previous step emerged. Those categories represent the central statements made with respect to RQ2.1 and RQ2.2 and they are labeled as: Reasons to invest in the CE; The investment goals of the VCs; The VCs' role in the transition; Barriers; Benefits of investing in the CE; and the considered risks.

4. Results

This section first presents the results of the content analysis regarding RQ1.1 and RQ1.2. Following this, the results of the interviews connected to RQ2.1 and RQ2.2 are illustrated.

4.1 Results for RQ1

The following section provides the results for RQ1.1 by describing in what type of CEBM and design strategies the capital of the investigated public equity funds is flowing.

4.1.1 Product types

The distinction between all products, selected products, by-products, and packaging reveals that most companies the funds invest in do not have a fully circular business model. Instead, they rather implemented circular design strategies or CEBMs for selected products. For instance, only 20% of the companies have a fully circular business model, while 66% apply the principles of such BMs on only selected products. What this entails, in particular, can be illustrated by two examples. On the one hand, one of the funds invests in a recycling company called 'Re:NewCell'. The firm produces recycled fabrics made from old garments. Hence, they create value through recycling which applies to all of their products which makes their entire BM based on a CEBM strategy (ReNewCell, 2023). On the other hand, another company that was analyzed, called 'Thermo Fisher Scientific', has a take-back system in place and offers refurbished equipment for laboratories. However, in this case, not all products in their portfolio are part of this program, and the majority of the products are still produced in a conventional way (Thermofisher, n.d.). Therefore, the company creates value through the circularity practice of refurbishment but only with selected products. Consequently, it cannot be claimed that the entire BM is based on a CEBM strategy.

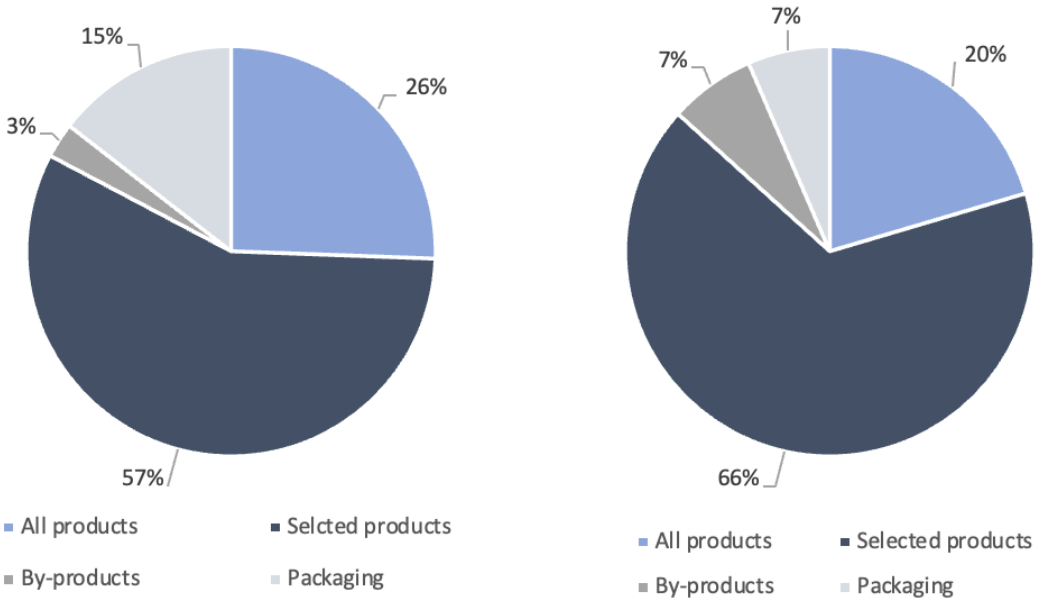


Figure 5 (left) & 6 (right) Fig. 5 shows the share of product types in % of all product types within the design strategies; Fig.6 shows the shows the share of product types in % of all product types within the CEBM

Furthermore, the share of by-products (design: 3%; CEBM: 7%) and packaging (design: 15%; CEBM: 7%) is rather low, which indicates that most of the applied circularity practices are actually implemented on products that belong to the product portfolio of the companies. The results of the product types are presented in Figures 5 and 6.

4.1.2 Design strategies

A closer look at the design strategies discloses a rather fragmented picture. With around 1/3 of all observed design strategies applied, the 'design for recycling' occurred by far the most often in the data set. The design for recycling entails that companies design their products in a way that the used materials can be continuously recycled. For example, the company 'Microsoft', which is an investment target of several of the funds, has created a data center that is designed in a way that critical parts can be recycled. By doing so, the company aims to reduce its IT waste through using materials again instead of disposing of them (Mircosoft, 2021).

The remaining 2/3 of the design strategies are rather equally distributed amongst the other designs of the underlying framework with a share of 5-10% per strategy. Some outliers are the 'design for reduction of production steps', 'design for standardization and comparability' as well as 'design for attachment and trust' with a share of each 1% (see fig. 7).

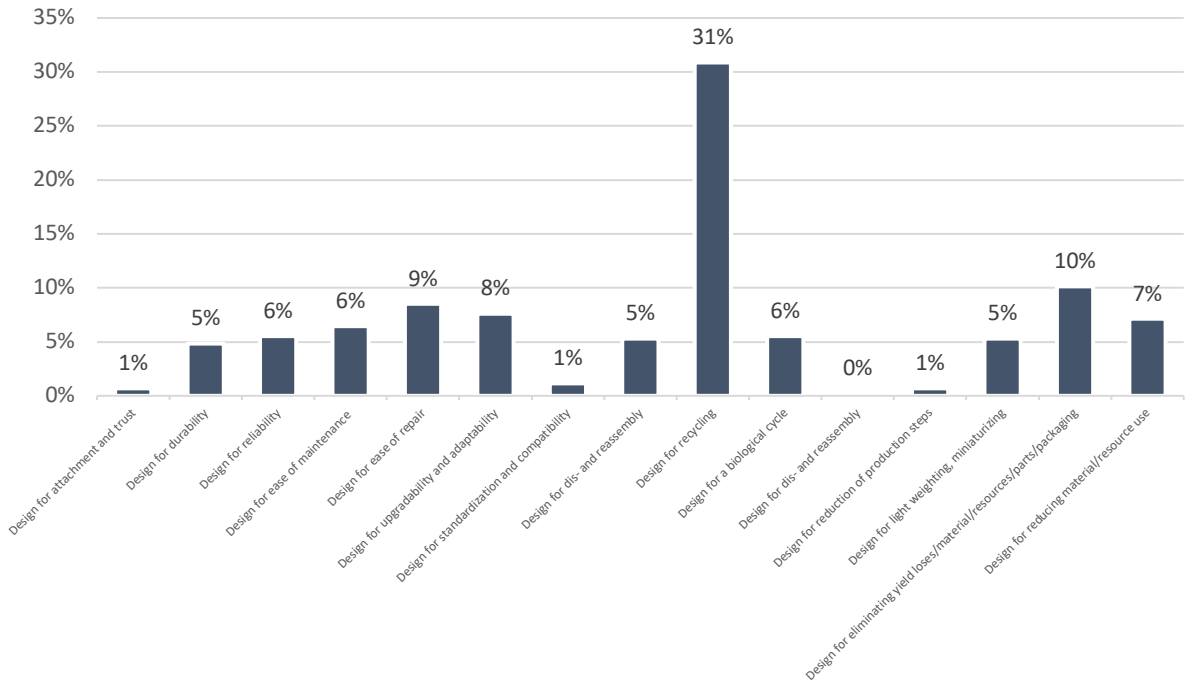


Figure 7 Share of design strategies in % of all design strategies

Moreover, it is striking that only 6% of the design strategies could be assigned to the biological cycle, which refers to the usage of healthy and biodegradable materials. Companies in the data set that apply such a product design often focus on the usage of biodegradable materials. For example, the firm 'Costco Wholesales' developed compostable packaging for some of its products (Costco Wolesales, 2022).

Design strategies of the biological cycle fall under the broader concept of closing resource loops. The second strategy within this category is the design for recycling, which constitutes a notably substantial portion of the overall approach. Combined, these two design strategies, focused on closing resource loops, account for approximately 37% of the total[2]. Furthermore, design strategies for slowing resource loops amounted to 40% and narrowing resource flows to 23% (Fig. 8).

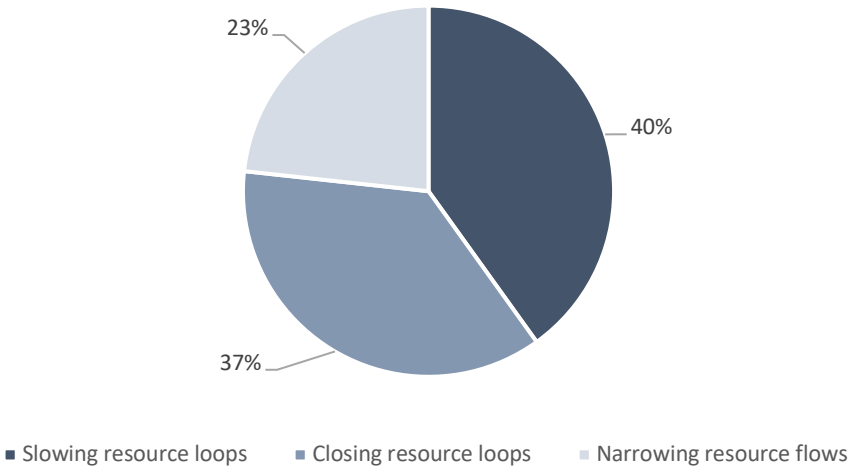


Figure 8 Share of resource loops in % of all resource loops within the design strategies

To get a better overview and gain more in-depth insights into which type of circularity practices were applied within the respective design strategies, each of the observed design strategies was allocated to a R-imperative of the R-ladder. With around one-third of all applied R-imperatives, the results confirm that a significantly high percentage of the applied design strategies contribute to recycling (see Fig. 10).

[2] In Bocken et al's. (2016) framework closing resource loops also contains the design strategy 'design for dis- and reassembly'. However, the same strategy is also part of the slowing resource loops strategies. Therefore, when it was observed that a company applies such a strategy, it was only coded in the slowing resource loops category to avoid double counting.

Another third was assigned to the R-imperative reduce, which is one of the highest imperatives on the R-ladder. Having a closer look on where those reducing imperatives occur reveals that 70% of them were observed within the 'narrowing of resource flows' category (see Fig. 9). As described in the theoretical framework, design strategies within this category mostly contain internal measures like using fewer materials per unit of production. The various measures that are applied within this category by the investigated companies are versatile. For instance, the company 'Cummins' a producer of machinery for the mobile sector, reduces its consumption of materials in the production process (Cummins, 2022). Others, like 'Coca Cola' focus on their packaging and especially on using less fossil-based materials like plastic (Coca Cola, 2022). While a third category of companies, like 'Avery Dennison' reduced the waste production of their products. The company produces packaging and labels and developed novel technologies like printers to produce less waste during the production and usage phase of their products (Avery Dennsion, 2023).

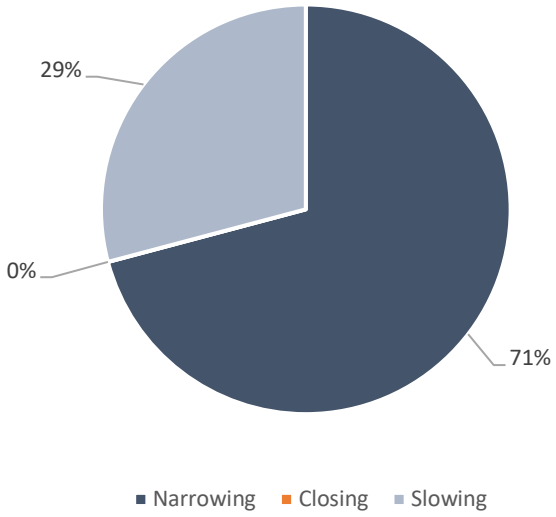


Figure 9 Share of 'reduce' practices in % of all 'reduce' practices within the resource loops of the design strategies

The remaining third of the R-imperatives within design strategies are dominated by maintenance/repair (14%) and refurbishment (12%) strategies. Generally speaking, those strategies comprise products that can be easily repaired or refurbished by design. For example, the company 'Caterpillar', which produces mining equipment, and offers a take-back program, where used products are repaired and refurbished to sell them again.

Finally, it can be seen in Fig. 10 that many of the R-imperatives were not applied within the design strategies.

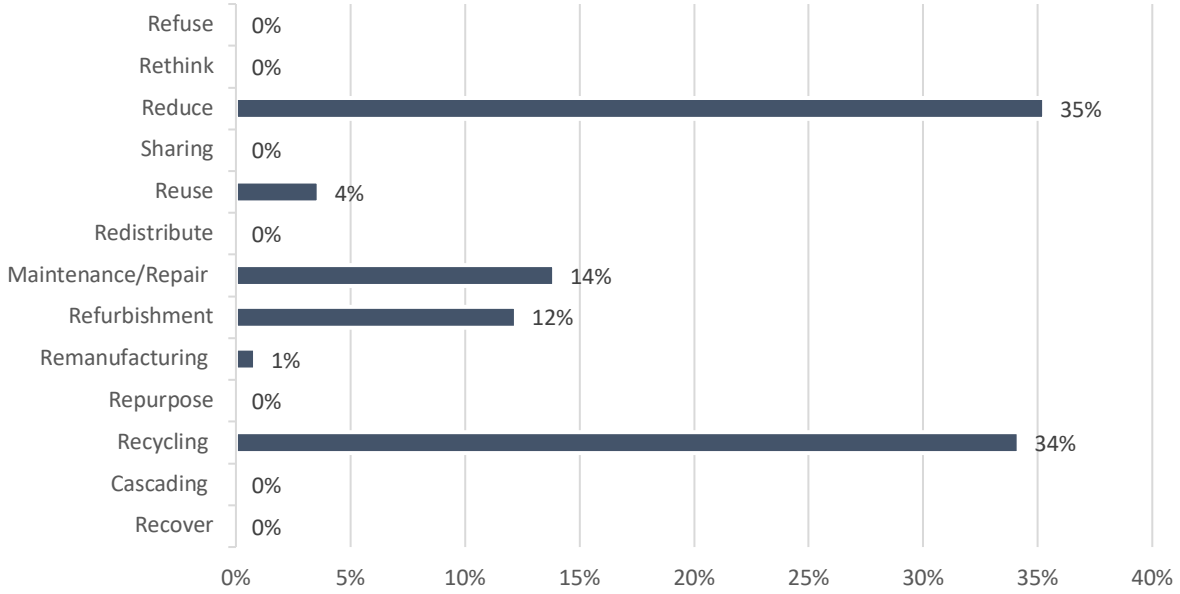


Figure 10 Share of R-imperatives in % of all R-imperatives within the design strategies

4.1.3 Circular business models

The distribution of the shares of the CEBM is less fragmented than the one of the design strategies. However, here as well, around one-third of the CEBMs were allocated to recycling. The main difference between the design strategy for recycling and the recycling BM is that the design strategies contain measures where a company only uses recyclable materials. To be allocated to the recycling BM, however, a company must actually recycle itself or use materials that have been recycled before. For example, the tire producer 'Michelin' recycles tires to produce new ones or materials for other products thus creating value through recycling (Michelin, 2023).

The second most prominent position is the 'maintenance/repair BM', which amounts of 18% followed by 'refurbishment BM', with a share of 13%. The 'access and performance model' to which product service systems (PSS) were assigned to only accounted for 7%. For such BMs, the company offers a service instead of the ownership of a product. The company 'Trane technologies', for instance, offers a rental service for a variety of machinery, like cooling or heating equipment for commercial purposes or generators. The service includes setting up, installing, and operating the assets. By doing so, the firm offers the service of their products (for example, cooling something down) instead of selling their ownership (trane technologies, 2023).

The share of the remaining CEBMs is relatively small and makes up between 0%-8%. An overview is presented in Fig. 11.

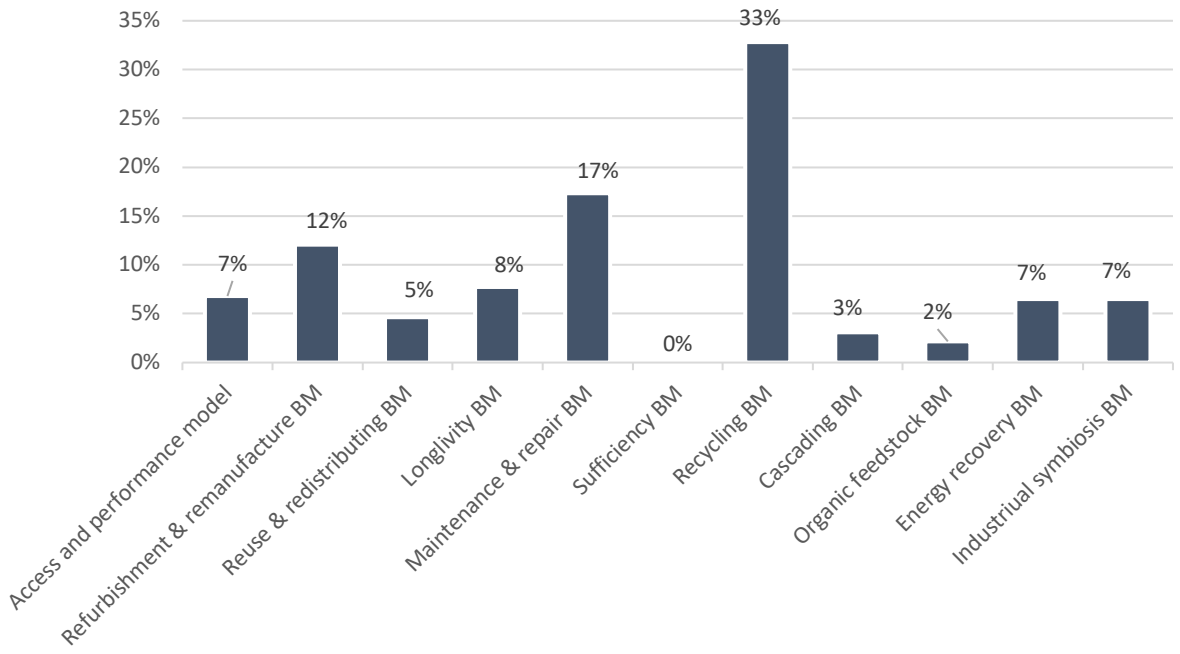
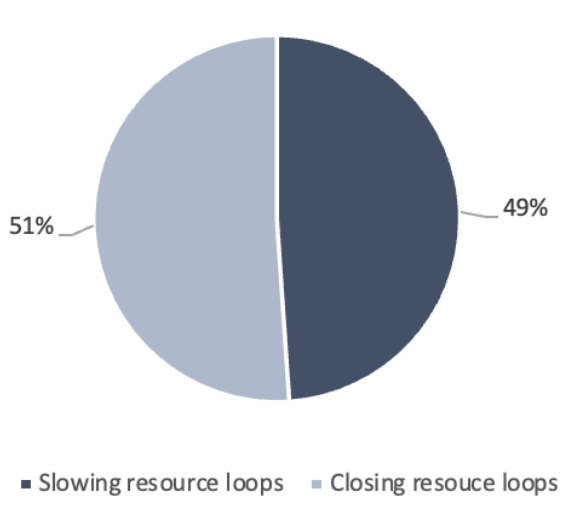


Figure 11 Share of CEBM in % of all CEBM

Within the CEBMs too, the amount of practices that can be linked to the biological cycle is very small. These include the 'cascading BM', the 'organic feedstock BM', and the 'energy recovery BM', and together they account for 12% of the CEBM. However, the distribution between closing and slowing resources loops was almost 50/50 (see Fig. 12 &13).



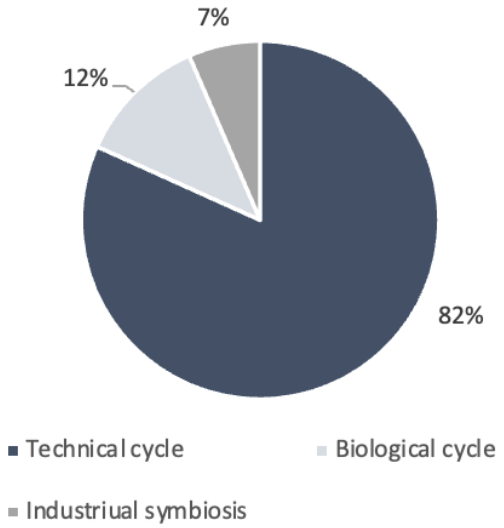


Figure 12 (left) & 13 (right) Fig. 12 shows the share of the resource loops in % of all resource loops within the CEBMs; Fig. 13 Shows the share of the biological and technical cycle as well as industrial symbioses in % of the total of the three aspects within the CEBMs

Assigning the R-strategies within the respective CEBM again reveals some additional insights (see Fig. 14). Recycling remains the most occurring R-strategy, which amounts to 33%. However, compared to the design strategies, 'reduce' plays a much minor role, with a share of only 8%. In the case of the CEBM, reducing strategies were mostly applied within the longevityBM (83% of the reducing measures occurred in this BM). This BM refers to the value creation through long-lasting and durable products. For instance, the fashion company 'marimekko' claims to produce high-quality garments with a timeless design. This is supposed to encourage their customers to reduce their consumption through using the clothes longer instead of buying new ones (marimekko, 2023).

Maintenance/repair (17%) and refurbishment (10%) again account for the second and third most often applied R-strategies with a similar share to the design strategies. Sharing, a major strategy that can be linked to PSS has a rather small share with only 5%. The same applies to the remaining R-strategies which amount of 10% (cascading), 7% (recover), 5% (reduce and redistribute) and 1% (remanufacturing).

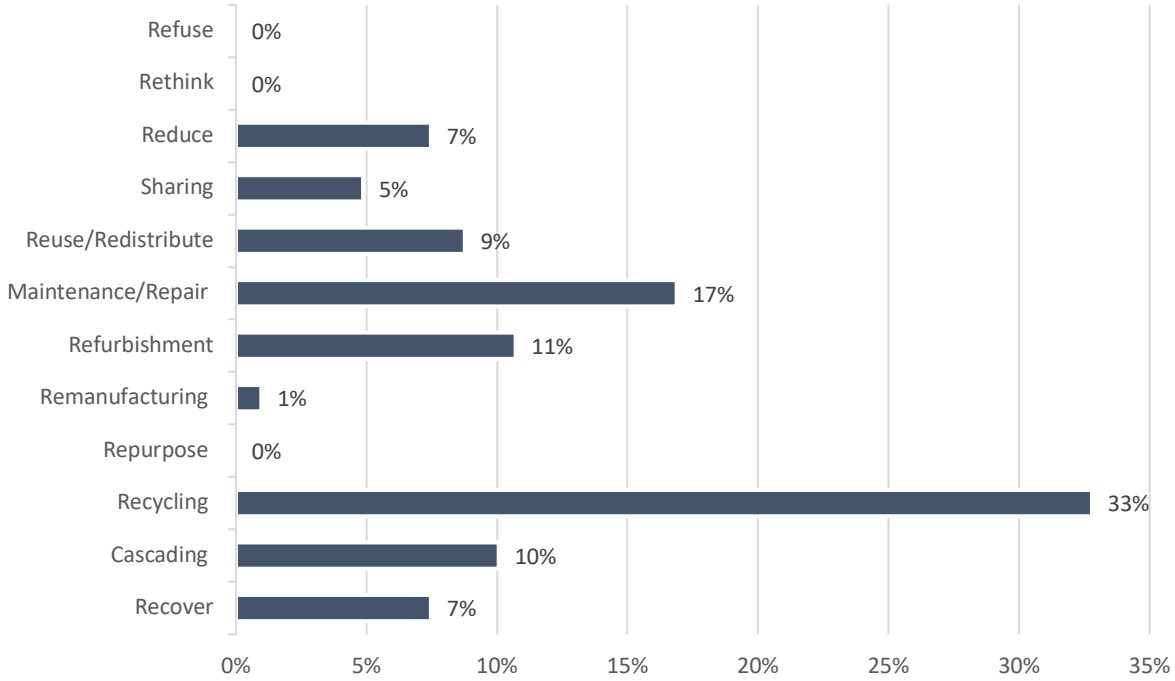


Figure 14 Share of R-imperatives in % of all R-imperatives within the CEBMs

4.2 Results for RQ2.1 and RQ2.2

In this section, the results of RQ2.1 and RQ2.2 are presented, aiming to investigate the incentives and motivations of VCs to invest in circular practices as well as their role in the CE transition. The results are based on an inductive coding approach of the 12 interviews with employers of VCs with a circularity focus.

The six categories which emerged during the coding process serve as the structure of this section.

4.2.1 Reasons to invest in the CE

The first category that emerged during the coding process is related to the reasons for the VCs to invest in the CE. This includes to what extent the CE plays a role in the investment decisions of the VCs, what their understanding of the concept is, and if they are particularly interested in certain practices within the CE.

As aforementioned, all the VCs the interviewees work for have a focus on sustainability and have at least one start-up in their portfolio that can be linked to the CE. Consequently, the participants of the interviews confirmed that the CE is an interesting concept for their investments. However, the results also show that the CE only plays a subordinated role in their investment decisions and is mainly interesting as it contributes to the higher-level goals of the investors. These goals are twofold and either economic or sustainability related. As one participant stated: "*The important thing is, not only for the circular economy but for any business, effectively they have to be cost leaders so economically viable or proposition. And the second thing is they need to have a strong sustainability angle*."

From an economic perspective, the CE was claimed to provide an interesting business opportunity as there is a market for CE related solutions. On the other hand, the concept has the potential to contribute to the sustainability goals that the VCs have set for themselves and seek to achieve through their investments. An often-mentioned focus within these sustainability goals are climate related goals, as the CE is seen to be less carbon intensive than related linear practices. One participant, for example, reported that they "*focus every year on measuring the CO2 emissions that all [their] portfolio companies can avoid, and circular economy is obviously one of the best examples [they] can have on that*". Other participants were more broad and stated that they are looking for investments that bring a "*social or ecological value*", and since the CE promises to do so, it is considered an interesting concept.

Since most of the VCs did not have a particular focus on the CE but rather viewed the concept as a mean to achieve their sustainable and/or economic goals, they also did not prefer certain practices within the concept (e.g., recycling etc.). Instead, the investors are rather looking for start-ups that fit in their investment criteria by fulfilling certain sustainability and profitability standards. As an illustration, one of the VC firms is directing its attention towards companies involved in deep-tech and climate-tech sectors. Consequently, when engaging in

the CE space, this fund prioritizes CE-related companies that align with their deep-tech focus. They specifically emphasized principles of CE that involve recycling, as it necessitates the establishment of recycling plants, which falls under the realm of deep-tech solutions, as opposed to reduction measures, which primarily require changes in consumer behavior.

4.2.2 The investment goals of the VCs

This section outlines the goals pursued by the VCs in their investments and explores the factors that shape these goals In this case, the goals refer to the VCs' underlying objectives to invest in CE startups. This is supposed to contribute to a better understanding of why the start-ups chose to invest in the CE instead of other asset classes.

All investors claimed that they follow the goal to generate returns while creating an environmental or social value. The primary paradigm behind this goal is providing start-ups with equity capital to help them grow, and at some point, selling their shares to receive a profit. Impact in this way is created by choosing companies and solutions that contribute to at least one of their sustainability focus areas in which they want to create social and environmental value.

Moreover, it was argued that with the growth of the companies, the impact increases as well. Accordingly, one of the participants stated: "*Basically, if you have a viable business model that happens to have a very innovative and sustainable technology and they are able to get enough market shares and it works from a business perspective, ultimately, you're going to have the maximum impact because more and more, customers etc. have been adopted*."

The underlying goal of investing in circular start-ups is the contribution to a SD which was either formulated more broadly or captured in a concrete goal like the reduction of CO_2 emissions through the investments as mentioned before.

On the other hand, the VCs intend to generate a financial profit for their own investors by selling their shares after completing the investment. As emphasized by one participant: "*As a venture capital fund, we have our own investors to whom we promised some returns. This is made with the promise that sustainability markets, the circular economy or, the bio economy are growing. So, [the investors] want to invest and generate some profits*."

When discussing their goals in the circularity transition, the informants expressed that it is something they are indeed aiming for. However, they expect the transition to emerge more indirectly though the growth of start-ups they invest in. Moreover, it was not specified as a requirement for a company to contribute to such a transition to receive funding. One

participant even stated that "*as long as the company generates demonstrable added value and I get my money back and they stay in their niche, that's not an exclusion criterion*."

Furthermore, some of the participants made a clear distinction between their personal goals and the VC's goals. While the VC as an economic player in a capitalistic system, must generate profits, the participants themselves also have an intrinsic motivation to contribute to a sustainable world and to preserve the planet we live on. This was described by one participant as a "*joy of doing something that you believe is good for everyone and yourself and your children*".

Drivers

Based on the VCs' goals, it can be determined what the driving forces are that influence their investment decisions/focus.

One of the biggest drivers is the VCs' own investors, which provide them with capital to make their start-up investments. These can be different types of institutions like pension funds, wealthy private persons, or incumbents. The commonality among all of them is their pursuit of returns, indicating their expectation to recover the capital they have invested in the VCs along with a profit. This obviously has a significant impact on the VC's work as in their investment decisions they must keep in mind that a potential investment must fulfill the profitability expectations of their own investors. Accordingly, one interviewee claimed: "*if we cannot, fulfill the requirements of our investors, then we won't have a chance again [to raise capital]*."

Furthermore, a second driver is the increased demand on the market for sustainable solutions and technologies. "*Companies because of COVID and all the supply chain shocks realize that there is more to it than simply doing business and simply being green, but they realize the importance of being sustainable*". It was described that markets, industries, and incumbents are more and more shifting towards sustainability, and consequently, investors are looking for "*technologies that can either complement [their] portfolio or become really competitive in the future*". Due to this increased demand, circularity becomes a business opportunity that makes it possible for the VCs to generate profits with their investments.

4.2.3 The VCs' role in the transition

This section presents how the VCs perceived their role in the circularity transition. It is important to mention that this is not the final answer to RQ2.2 but only describes how the VCs see themselves in the transition.

Generally speaking, all participants claimed to have the ability to play a role in the circularity transition. How they perceived this role was closely related to their goals and described similarly amongst the interviewees. The primary notion behind this is that by offering financial resources to the "right" start-ups – namely those that meet their sustainability requirements - these companies have the opportunity to expand their presence in the market and simultaneously enhance their circularity impact. This means that with their technical and market expertise, the VCs consider themselves as enablers for change as they are "*able to see which startups make a very positive contribution, have a solid technical background and also have a good business case which can promote the field*."

Although expressed in various ways, the tangible impact on the transition was consistently mentioned to be rooted in the notion of growth. Some of the interviewees emphasized that they are providing start-ups with a high-risk profile with capital that would otherwise not get a loan (e.g., from a bank). This helps them to farther develop their technology/solution and make it "*financially attractive*" for bigger markets. One informant framed it as "*diverting capital to impactful purposes on a very high level*."

This entails an enabling function since these start-ups have the potential to provide more sustainable solutions, however, they need further development to reach a trajectory where they can actually have an impact on the transition. Since the VCs are often the only ones who are willing to take the risk to invest in these young companies, the participants perceived themselves as important enablers in the transition by supporting start-ups to grow and reach this trajectory. One informant expressed: "*we enable new technologies scaling up. Of course, you could have a great idea that is very sustainable. Very environmentally friendly. It could also be profitable, but if you cannot take it to the next stage in terms of your scale, then it's not going to work out. So, we enable expansion of sustainable technologies in the market*."

Moreover, besides providing the start-ups with capital, the VCs also offer stewardship on a management level to help them grow. "*We tell them what to do better and we ask them to change the governance structure. We try to exchange one or two of the management team members, give them other positions in the company to try to restructure the company. In order*

to survive in the market much better. We try to find synergies with other companies that we have. So, we really try to assist the companies."

Furthermore, another effect highlighted by several interviewees, which was linked to their role in the transition, was the ability to demonstrate through their investments that impactful initiatives can also be financially appealing, thereby presenting an attractive investment opportunity. One participant explained that they "*can be a front runner as a sustainable investment fund to show other more traditional investors: Hey, this is a very good investment strategy and show them the profitability of these investments to shift the whole financing environment more towards sustainability*."

Accordingly, the effect that investors have on the transition arises from the fact that, as role models, they demonstrate the attractiveness of sustainable investments and convince other investors to engage in the same field. If investors successfully implement sustainable projects and achieve good returns in the process, other investors may be encouraged to also invest in this area.

4.2.4 Barriers

The fourth category that emerged during the coding process are barriers that the participants identified and that hold them back from investing in the CE. These barriers are divided into three sub-categories which are: barriers related to conventional finance; start-up related barriers; and structural barriers.

Barriers related to conventional finance

The first category refers to barriers related to practices of conventional finance which do not necessarily consider circularity aspects but are still quite dominant in the field.

Amongst the participants' responses, it was claimed that "i*t is not yet the case that the financial market is driving the economy or politics ahead*" in the circularity transition. As a primary reason for that, it was identified that the classical capital markets are still using their conventional assessment metrics, which focus on purely financial criteria. Moreover, those criteria are financially speaking too successful as they are still generating profits. The same applies to conventional VCs, which are still creating "*attractive investment cases that are not sustainable, so a lot of money goes to them*". Accordingly, investors continue to be incentivized to apply conventional valuation criteria as they achieve the desired profits. However, this is

problematic for the circularity transition as those criteria neglect social, environmental, and circularity aspects.

A more VC specific barrier that was mentioned amongst several informants was the conventional time horizon of VC investments. A typical VC investment is set out over a period of 10 years. However, the interviewees claimed that this is too short to develop CE related technology since they are often dependent on hardware which needs more time in development to become ready for the market. Consequently, the VCs must reject many start-ups which have an interesting technology from a CE perspective, but which are not expected to create a sufficient profit after ten years. One informant, for example, reported: "*For a lot of companies, […] this timeline becomes challenging, because there is a lot of hardware investment that we need to make in order to transition to a sustainable economy. Battery technology, material science, that kind of stuff takes time and investing in that requires more patients than ten years*."

The root of this issue lies in the expectations of the venture capitalists' own investors. These investors seek to recoup their investment, along with a profit, within a 10-year timeframe. As the requirements for capital provision are typically set by these investors, venture capitalists must conform to those standards to secure funding for their own investments. Consequently, the capital is directed towards start-ups that are expected to generate financial returns within a 10-year period.

Start-up related barriers

Besides those rather finance related barriers, there are also aspects that refer to the (potential) start-ups the VCs invest in, and which make it difficult to steer more capital towards the CE.

Generally speaking, the investors claimed that many of the start-ups that are potential investment targets do not meet their requirements during the due diligence process, which a company must fulfill to receive an investment. In most of the cases the investors claimed that even though the start-ups have "*very sustainable*" solutions, they often do not meet their economic requirements. One interviewee reported: "*We try to invest in circular companies, but sometimes they are not profitable or even oftentimes. So, we take a look at 500 companies every year, but we invest in 5. So, a lot of […] potential investment targets turn out to have some type of deficiency that we cannot accept*".

These deficiencies could be, for instance, that there is currently no real market for the products the start-ups offer; they are not expected to bring a financial return; their technology

is too complicated and/or expensive for the market; the technology is not expected to be able to compete against existing solutions on the market; or more formal aspects like a missing registration of intellectual property which would make it too easy to copy the technology.

Furthermore, and as mentioned before, circular investments were described as capital intensive, which makes them more difficult to finance than, for example, digital solutions. "*A lot of companies in the sustainability space have a lot to do with facility building, meaning you have to build up your fermentor or if you have like a fermented asylums or mushrooms for alternative protein or you need to get equipment and machinery and that costs a lot of money*". Finally, these arguments indicate that many of the circular start-ups are considered as too risky by the investors primarily due to profitability reasons.

However, it was not only the financial performance of the circular start-ups that was reported to be insufficient to become an attractive investment target but also the sustainable one. Due to their sustainability focus, the VCs have clear requirements regarding the sustainability impact of their investments which start-ups often fail to live up to. Even though many of the companies they assess seem sustainable in the first place, their monitoring often reveals that there is some type of deficiency which does not conform to the standards of the investor.

One participant gave an example of a company that produces artificial leather, and that was assessed as a potential investment target. The raw material was based on biomass and "*super sustainable*". She further explained "*if it just would stay this way, it would be absolutely fine. But the company gives the biomass a certain coating, and they process it again and put a lot of chemicals on it in order for the material to be a weather resilient. And then this material is absolutely not recyclable anymore. So, the basis is super biological, super circular and super great. But if you give it a different color and if you make it weather resistant, it's absolutely not circular anymore. It's not sustainable. It's not recyclable*". Therefore, the technology failed to meet the sustainability requirements of the VC and was not considered as an investment target anymore.

Structural barriers

The final category within the barriers to investing more capital in circular related start-ups entails structural barriers.

On the one hand, those barriers were related to an incumbents' resistance to adopting new circular technologies and solutions. One participant commented: "I*f you talk to bigger*

corporates and bigger industry players, they're saying, for instance, with bio-based coating, biobased polymers: Oh, that's great. That's more sustainable. It's bio based. But can you produce it in tons? Because if you can't produce it in tons as a supplier, we can't risk our business". Accordingly, the resistance is mainly caused by a lack of performance and maturity of the novel solutions but also a missing consumer acceptance amongst the incumbents' customers.

4.2.5 Benefits of investing in the CE

Regarding the benefits that result from investing in circular solutions, one main pattern could be found amongst the answers of the participants which relates to the attraction of capital. Many respondents stated that as a fund investing in the CE, it is easier to raise money from investors on the market. However, it is usually not the CE focus per se which facilitates the acquisition of capital but rather the sustainability effects that come along with it. It was reported that especially amongst institutional investors like pension funds, there is an increased interest in the topic, and they are seeing sustainability as an asset class they want to invest in ("(…) *it's a much more future proof investment for venture capital funds, I think it's almost impossible to raise funding if you're not investing in sustainability nowadays. So, all the institutional investors really want to see this*.").

The increased interest was explained by the participants as being driven by several factors, like the investors' customers who are demanding such investments. Some of the investors want to push the market opportunity. Moreover, "*some of the investors want to improve their carbon footprint, some, some of the investors, want to get access to new novel technologies. Some just want to diversify their portfolio*."

4.2.6 The considered risks

Finally, the last category that emerged during the coding process relates to the risks the investors consider in their investment decisions. This refers to the assessment criteria that are used to analyze a potential investment target and whether the investors consider circular investments as more or less risky than conventional investments.

Regarding the investment criteria the investors use to anticipate the performance of potential investment targets, the results show that sustainability plays a central role and, as aforementioned, determines the attractiveness of the start-ups for the VCs. Therefore, many of the investors had clear requirements for the sustainability performance of the companies

they invest in. As exemplified by one respondent: "*We condition our investments to double positive impact. The first one is on is the activity. Which means, the product or the service of the company we invest in has to contribute to solve a social or an environmental challenge like climate change, the preservation of biodiversity, resources, air quality, education, well-being, health and so on. And this is in line with the United Nations Sustainability Development Goals*". However, it became once again clear that the VCs do not consider specific CE criteria in their assessments but rather see the concept as an option for a sustainable investment.

However, next to the sustainability impact of the companies, their financial performance obviously also played a significant role in the assessment criteria. Hence, the interviewees oftentimes referred to a balance between sustainability and profitability which must be given in a company to become an interesting investment target. The balance between the financial and sustainability aspects in the assessment of the potential investment targets results in an extensive risk assessment influenced by the VCs' investors who have their own requirements which must be addressed to attract capital.

Closely related to this, a majority of the respondents stated that circular investments are not riskier than conventional ones but might be even less risky. There are different reasons for this. For instance, the consideration of not only financial risks but a more holistic approach which also considers e.g., environmental, and social risks. According to one participant for example, an investor "*reduces the event risks*" like reputational risks, by considering sustainability aspects. This protects them from total failure, as shown by the BP oil platform case in the eighties. Secondly, it was argued that current market and regulation developments are favoring sustainable investments, which also makes it less risky to invest in the CE since there is a demand for those investments and technologies. For example, it was argued that policy pressure and consumer demand steer investments toward sustainable investments like such into the CE.

However, it was also emphasized by the investors that VC investments are always characterized by a high-risk portfolio as they invest in young companies with the uncertainty whether they will establish themselves on the market.

5. Discussion

5.1 Discussion of RQ1.1 and RQ1.2

In this section, the previously presented results are discussed. First, the results of the content analysis are discussed to provide more information on RQ1.1. To do so, the existing literature was reviewed to find possible explanations from previous studies why (or why not) public equity funds invest in the respective circular design strategies and business models. By doing so, not each design strategy and CEBM is discussed individually but only the most important findings are analyzed. This also serves as a foundation to answer RQ1.2, which follows the discussion of RQ1.1.

Following this, the discussion of the results of RQ2.1 and RQ2.2 is presented.

5.1.1 The investments by product type

As described above, a majority of the investments went into companies that only implemented circular design strategies and/or CEBM on selected products. These results are not surprising as the analyzed companies are primarily incumbents. The process of the transition to a circular economy is still in the beginning, and implementing circularity practices is often considered to come with a variety of risks and uncertainties (de la Cuesta-González & Morales-García, 2022). Consequently, public equity funds that are known to be rather risk averse were not expected to invest in radical novelties like companies that run a completely circular BM and which opposes the current still dominant linear model (Mazzucato, 2013; Nykvist & Maltais, 2022; Stumpf et al., 2021).

Moreover, many companies are still experimenting with the implementation of different circularity practices. Hence, the maturity of these BM is rather low (Chen et al., 2020) which can also be considered as an investment risk for investors and explains why they would rather invest in traditional linear companies that started integrating circularity practices in their business.

However, not only preferred the investors not fully circular BMs but also it can be seen that they favor some CEBM/design strategies over others. This will be discussed in the following.

5.1.2 Investments into recycling

With around one-third of all the observed CEBM and design strategies, recycling plays a significant role in the investment targets of the funds. The dominance of recycling in circular businesses was also found by previous N-studies that investigated the implementation of different R-strategies in companies (Barreiro-Gen & Lozano, 2020; Stewart & Niero, 2018; Stumpf et al., 2021). For this study too, the high share of recycling strategies was to be expected. This is, on the one hand, because most of the companies the investors invested in are incumbents which, generally speaking, prefer lower R-strategies (such as recycling) on the R-ladder as they come with less implementation risks and uncertainties (Henry et al., 2020; Stewart & Niero, 2018).

To create value from the implementation of recycling a company can either sell recycled materials or use them to produce their products. Especially the latter makes recycling an attractive practice since companies do not have to change a lot in their current processes while implementing a circularity practice in their existing BM (Ranta et al., 2018).

The implementation of circularity in an existing BM usually requires the focal company to take a new position in the supply chain while still managing its core BM. Since recycling often comes down to the substitution of raw materials, the new positioning in the value chain would be, for instance, waste management (Ranta et al., 2018). However, its implementation usually does not require any other significant socio-institutional changes like in other R-strategies, as it will be shown later in this section. Consequently, there are not many major socio-institutional barriers, like a change in consumer behavior, in the implementation of recycling which makes it less risky for companies and investors.

This pattern was observed in several of the investigated companies. The 'Ball Corporation', a producer of aluminum packaging, for instance, uses recycled aluminum for their products. The collection and recycling process itself are outsourced, and the company buys the aluminum recycled instead of as a raw material (ball cooperation, 2023). Hence, the company can still produce and sell its existing products and faces barely any additional risks from implementing a CE practice.

Furthermore, and maybe even more important form an investment perspective, recycling is often implemented for profitability reasons (Salvador et al., 2020). Such a focus on monetary aspects over e.g., social and environmental ones as the main driver for implementing recycling in the respective companies would be in line with the argumentation

of Ranta et al. (2018), who state that the main reason for companies to implement circularity in their business is cost efficiency. For investors looking for risk-adjusted returns, a company that achieves a cost leadership due to the implementation of recycled materials is, therefore an interesting investment opportunity (Nykvist & Maltais, 2022).

Finally, recycling is a respected R-strategy in the transition towards a CE and may be the currently best available practice for closing the loop of some materials. However, a too strong focus on recycling bears the danger that higher R-strategies are being neglected (Reike et al., 2018). Hence, their implementation will be analyzed in the following.

5.1.3 Investments into repair, maintenance, and refurbishment

The second most occurring CEBM in the companies the funds invested in were repair/maintenance (17%) as well as refurbishment (10%). Likewise, these practices played a relatively significant role in the design strategies. Different aspects can explain this high occurrence.

First, the implementation of repairing/maintenance as well as refurbishment practices are part of the technological cycle and often require high up-front investments in new infrastructure which makes them more likely to be implemented in incumbents as they have the financial means to makes these investments (Henry et al., 2020; Stewart & Niero, 2018).

This becomes clear, for example, when looking at the refurbishment program of 'ASML' a Dutch supplier for the semiconductor industry. The company takes back some of its products to clean, repair and tweak them to ensure that they perform to their original specifications. This process requires special machinery, engineers, and production steps that differentiate from the core business of producing new assets (ASML, 2022). Hence, building up the infrastructure for the program requires investments in technological assets which can be considered quite cost intensive.

Moreover, such practices often allow the focal company to save the net value of already used products/materials/resources, etc. (Linder & Williander, 2017). This applies especially to refurbishment practices where the existing structure of a product is kept by upgrading components and parts (Reike et al., 2018). Preserving the net value of already used materials could increase the cost efficiency of the production process of a company which is, as aforementioned, a central reason for companies to implement circularity practices (Ranta et al., 2018) and an attractive investment reason.

In the mentioned ASML example, this might also serve as a reason for the company to establish the refurbishment program. Especially in the semiconductor industry, which recently suffered from supply chain issues, having an additional source of materials through old products could contribute to securing a cost-efficient production (Sweney, 2021).

Another aspect that possibly explains the relatively high share of repair/maintenance and refurbishment practices is provided by Henry et al. (2020). The authors categorize circularity practices according to where they occur within a value chain and distinguish between three categories. Practices that require an interaction with suppliers fall under the category 'upstream'. Internal practices that directly affect the focal company are categorized as 'source' activities, while 'downstream' practices are related to the revenue model and the customer interfaces of a company (Henry et al., 2020).

A clear distinction of the observed CEBM in this study according to those three categories is not possible as they were not included in the coding process during the data collection. However, particularly repairing and maintenance services but also refurbishment practices can be linked to downstream activities with an active consumer involvement as this categorization is also made by the authors. In fact, the allocation of these practices to the downstream category with active consumer interaction bears some interesting insights. The direct interaction with the companies' customers and integrating them in their reverse supply chain is considered to reduce the barrier of high up-front investments for developing a reverse logistics network (Henry et al., 2020). This means that the customers take over the take-back systems that are usually rather expensive to implement as they directly send back products, materials, etc., which makes the whole process less cost-intensive for the focal company.

Preserving the net-value of already used products and materials, as well as reducing the implementation costs of take-back systems as reasons to implement repair/maintenance and refurbishment practices would again support the argumentation that the choice of which circular practice is implemented in a company relies mainly on its contribution to the creation of a financial value (Ranta et al., 2018) which at the same time makes them interesting for investors.

On the contrary, one must also acknowledge that even though the share of these R-strategies is relatively large compared to the other strategies in the data set, they are still not significantly high in absolute numbers. Consequently, there must be some barriers that outweigh the benefits of implementing them for the companies as well as for the investors.

Such a barrier could be, for example, that the implementation of these loops requires the integration of new stakeholders and partners in the value chain that are willing to participate in the recirculation activities. This includes not only suppliers and partners but also customers that need to change their existing consumer behavior and therefore require a more radical socio-technological change than for example recycling (Potting et al., 2017).

This can be seen in the refurbishment program the computer producer 'Dell' set up. The company takes back used products and, if possible, refurbishes them to put them up for resale. Clearly, this contradicts the current linear practices in several aspects. For example, customers must return their old products instead of disposing them. This requires a tack-back infrastructure that ensures that the products arrive at the point where they are refurbished. Additionally, the company works with partners that are conducting the refurbishment process and which must be incorporated into the value chain. And finally, it needs customers that are willing to buy a refurbished product instead of a new one (Van Weelden et al., 2016).

Moreover, validating such business models might be more difficult than for example of a linear BM (Linder & Williander, 2017). When assessing a BM, investors must validate its future success based on different scenarios. In the case of a CEBM with different resource loops, the products/materials/resources are brought back to the focal company and might even be used to produce new products. Hence the scenarios to evaluate the future success of the BM entail longer time horizons that lay farther in the future, as each resource loop must be considered. This is illustrated in Figure 16, adopted from Linder & Williander, (2017) which shows a simplified CEBM. It can be seen that for every time the product is brought back from the customer to the producer, costs occur. These costs are related to the tack-back system of the product where t stands for each time the product is circulating in the reverse cycle between the two parties. Simultaneously, the OEM can generate t=n times additional revenues for every time the product is sold to a customer again after it is brought back to the producer (Linder & Williander, 2017).

In a corresponding linear BM, however, the validation process ends at the point where the product is disposed or even earlier. As shown in Figure 15, which illustrates a linear BM, only the cost between the supplier and the OEM as well as the revenues between the OEM and the customer, must be predicated. The validation of future second (or third or t=n) revenues and costs through reverse cycles like repair/maintenance or refurbishment in a CEBM makes such BMs more challenging to assess for investors and thus less attractive. This is due

to the fact that the reverse cycles are positioned further in the future which is leading to additional costs, uncertainties, and risks in their prediction. This is particularly noticeable when comparing them to linear business models, as the latter benefit from planned obsolescence, which guarantees future sales for a company (Linder & Williander, 2017).

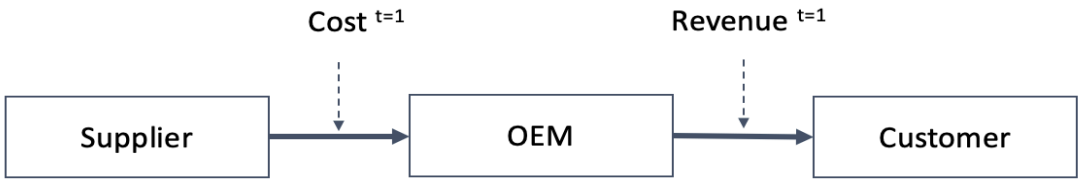


Figure 15 Simplified cost and revenue hypothesis of a linear BM adopted form Linder & Williander (2017)

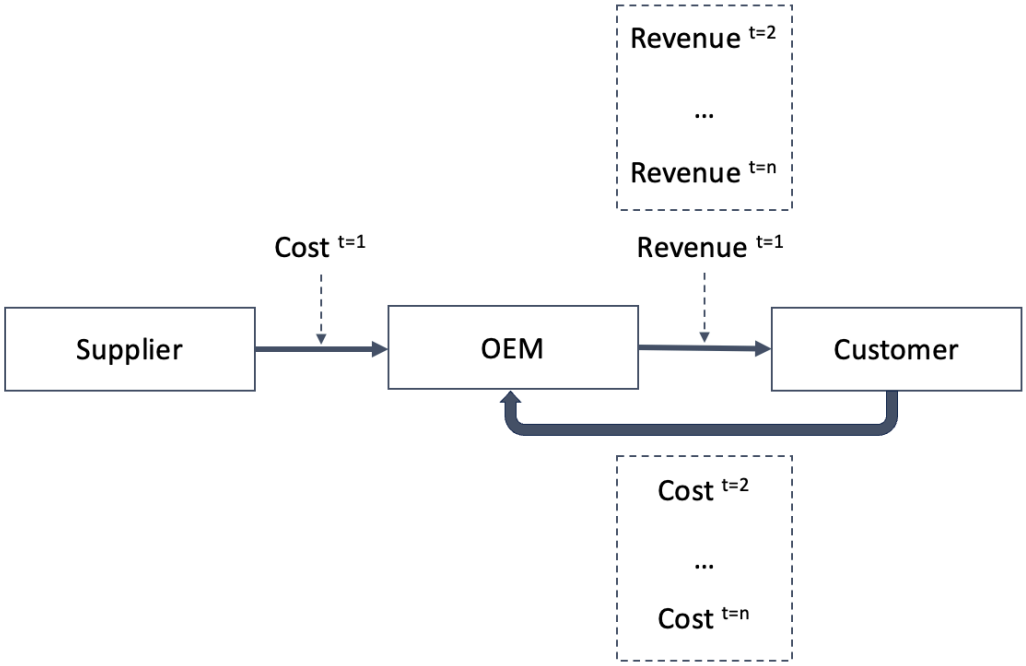


Figure 16 Simplified cost and revenue hypothesis of a CEBM including at least one reverse cycle adopted form Linder & Williander (2017)

Those risks, related to the required socio-technological change to implement repair/maintenance and refurbishment BM, as well as those related to the validation of such a CEBM, can be considered as barriers for investors, and they are possible reasons why the share of investments in these practices is still rather low.

5.1.4 Investments into reducing

One of the highest imperatives on the R-ladder is reducing. The results have shown that there is a clear gap between the share of the reducing practices implemented on a product design and a BM level. While reducing has a very high share within the design strategies, it is rather low amongst the CEBM. This calls for a more in-depth examination of this practice.

Reducing measures can be consumer-oriented or producer-oriented (Reike et al., 2018). Consumer-oriented reducing measures are often more challenging to implement as they require a change in consumer behavior, for instance, towards a longer or more careful product usage (Kirchherr et al., 2018; Reike et al., 2018). On the other hand, reducing measures that are linked to the producer are often easier to apply.

As aforementioned, 70% of the reducing measures within the design strategies fell under the narrowing category, which are internal practices aiming to use less materials associated with product and production processes (Bocken et al., 2016). These measures are easier to implement than the consumer-oriented ones, as they usually do not require any modification of consumption habits (Henry et al., 2020). This could be seen in the presented examples in the results, where all the implemented reducing practices implied the reduction of material consumption or waste production. However, the core product remained the same. Moreover, these narrowing practices often bear efficiency measure insight (Bocken et al., 2016) which makes them economically attractive – also for investors.

On the contrary, the reducing strategies within the CEBM mainly occurred within the longevity BM. Such consumer-oriented practices could require a more socio-technical change, as an example of the company L'Oréal illustrates. One of the company's brands introduced a reusable packaging as well as a refill station for a cosmetic product. Instead of throwing away the packaging after the product was used, the company wants to encourage its customers to refill the old packaging again, and by doing so reduce the material consumption for packaging (L'Oréal, n.d.). Thus, the concept can be assigned to the longevity BM as the packaging must be durable and steady to use it more often.

Implementing such consumer-oriented reducing measures can come with difficulties for the focal company. The consumer, who is used to throwing out the packaging after the product was used, now must keep the packaging, go to a store, refill it and use it again. Moreover, to use it several times, they also have to use it more carefully to keep it in a usable condition. And finally, the company also has to find new business partners who are willing to participate in this process, for example, by setting up a refill station in their store. These changes in existing structures and behavioral patterns are often difficult to change and make it harder to implement reducing measures on a BM level. (Henry et al., 2020; Potting et al., 2017). Thus, they bear a certain degree of uncertainty and risk, making them less attractive to investors.

5.1.5 Investments into product service systems

Product service systems (PSS) are considered by many scholars as one of the main enablers on a BM level in the transition to a CE (Henry et al., 2020; Hofmann, 2019; Salvador et al., 2020; Stumpf et al., 2021). Emerging from their stated relevance in the literature, they are discussed in further detail in the following section.

According to Tukker (2015, p. 76), a PSS is defined as "*a mix of tangible and intangible services designed and combined so that they are jointly capable of fulfilling a customer need*". The author distinguishes between 3 types of PSS:

1. *Product-oriented services* where the BM still focuses on selling a product, but some additional services are added.
2. *Use-oriented services* where a product still plays a central role, but the BM is not about selling the product but its functions and services.
3. *Result-oriented services* where the customer and producer agree on a result, but no product is involved.

The first category of PSS could include services like maintenance and repairing services which have been discussed above (Tukker, 2015). Hence, the focus of this section lies on category 2 and 3.

PSS are of particular interest for the CE transition as the producer of the product usually remains the owner and is thus incentivized to prolong the lifetime of the product so that its services can be used for as long as possible (Salvador et al., 2020; Tukker, 2015).

Despite their often-stated relevance in the CE transition, such PSS where the ownership is redefined do not often occur in the results of this study. The 'access and performance model' to which such PSS were assigned during the coding process only amounts to 7%. Additionally, sharing practices, which as defined in this thesis, can also be allocated to PSS (Salvador et al., 2020), only account for 5% of the R-strategies. However, these results are not surprising as PSS require a socio-institutional change to be successful (Henry et al., 2020; Hofmann, 2019; Salvador et al., 2020).

For example, introducing PSS requires a change in consumer behavior and habits as the customer does not hold the ownership of the product anymore but pays to use its services. Such change is often considered as rather radical and difficult to make as it contradicts current consumption patterns which are rooted in the customer's habits (Potting et al., 2017; Salvador

et al., 2020; Tukker, 2015). For example, the company 'signify' offers a light-as-a-service solution. Instead of selling light bulbs, the company offers installing, operating and maintaining lighting systems in commercial buildings. This requires a change in their customers' behavior as they no longer acquire the ownership of the light bulb but pay a fee for the service of receiving light (Signify, 2023).

However, simultaneously, a lack of consumer interest was found as one of the main barriers in the transition to a circular economy, as consumers are still focused on linear practices and do not seem willing to change those yet (Kirchherr et al., 2018). This needed radical change in combination with an immature market, make the implementation of PSS less attractive for companies as well as investors.

In addition, the missing market maturity is not only an issue concerning possible consumers of PSS but also business partners in the value chain. The implementation of PSS requires a close collaboration with the different stakeholders along the value/supply chain of a company (Hofmann, 2019). Such circular networks entail, e.g., suppliers, service suppliers, manufacturers, and retailers, amongst which the created value has to be fairly distributed (Achterberg, 2021; Hofmann, 2019; Salvador et al., 2020). Most companies, however, still operate in a linear system, which means that a company that wants to embrace a CEBM often faces the hurdle of finding appropriate partners (Kirchherr et al., 2018). Moreover, there is still a high institutional resistance within companies towards such change as the circular value networks can lead to high dependencies between the stakeholders, which results in a lack of trust in those partners (Salvador et al., 2020)

Probably even more importantly when it comes to determining the lack of investments in such CEBM, PSS often face a variety of barriers when it comes to financing them. This is because PSS differ fundamentally from linear BM in the way they create value (Palmié et al., 2021). In a linear BM, a company receives one payment when the product is being sold, which is an early stage of the product's life cycle. In a PSS BM, however, these payments are separated over the entire life cycle of the product as the company does not sell its ownership anymore but the service of the product. Once the service was provided, the product (e.g., the lighting equipment in the case of signify) returns to the company, and its service can be sold again to another customer. Consequently, the company receives smaller payments over the entire life cycle of the product instead of one big payment at the beginning (Achterberg, 2021; Aranda-Usón et al., 2019; Potting et al., 2017).

From a finance perspective, separating these cash flows bears several risks for the investor On the one hand, the company must make high upfront investments to purchase or develop the needed assets to provide the services to the customers. These assets, however, will not be sold afterwards but instead stay on the balance sheet of the company as operating assets with a very high value (de la Cuesta-González & Morales-García, 2022).

Such 'blown-up' balance sheets usually have two significant disadvantages. First, having a considerable amount of assets on your balance sheet is often considered with high capital costs, e.g., due to depreciation. Hence, to be profitable, the incoming cash flows must be higher than those costs (Achterberg, 2021; de la Cuesta-González & Morales-García, 2022; Potting et al., 2017).

Second, the increase in the size of operating assets often comes with a decrease in the company's liquidity which damages its creditworthiness (de la Cuesta-González & Morales-García, 2022; Potting et al., 2017).

Furthermore, the incoming cash flows lay farther in the future, are more challenging to predict as they may come in with a high frequency (sometimes even in minute intervals), and might come from clients with a low creditworthiness (Achterberg, 2021; de la Cuesta-González & Morales-García, 2022). All these aspects can be expected to be considered by investors with a low risk tolerance as uncertainties in the BM. Moreover, they are barriers for companies to implement such PSS and, as a result, serve as an explanation for the low occurrence in this study (de la Cuesta-González & Morales-García, 2022).

Summary

The results and discussion above have shown in which type of CEBM as well as design strategies the analyzed circularity funds invest in and provided some explanations based on the existing literature why those financial actors set a focus on certain CEBM like recycling and neglected others like PSS.

Recycling was by far the most observed R-strategy, and it has been argued that this is because of the low implementation risks as well as a general focus on profitability. A similar explanation was provided for the repair/maintenance and refurbishment BMs, which were the second and third most prominent positions in the results. hose BM can contribute to a company's profitability by preserving the net value of already used resources in the value chain. Moreover, they face fewer implementation costs due to the direct consumer interaction.

However, they require bigger socio-technological changes than recycling strategies which are risks for investors and may explain their still relatively low share. Those socio-technological changes are assumed to be even higher for reducing and PSS BMs and consequently they are expected to be riskier for investors. Additionally, PSS particularly face investment risks which may also explain their low share in the results.

The following section now aims to discuss RQ1.2 by analyzing the implications of those results for the role of the financial actors in the CE transition.

5.1.6 The implications of the results for the role of finance in the transition

The literature review has shown that financial actors are usually considered as being part of the regime, which also applies to the investigated investors considering the results of this study (Geddes & Schmidt, 2020; Geels, 2011). The investors seem to seek for risk-adjusted returns rather than being real accelerators for change and count on incremental changes rather than a radical system change. However, before going into detail about how this argumentation arises based on the results and discussion presented before, an alternative perspective is elaborated, where the investors of the funds are seen more as active enablers of the transition.

Investors as active enablers of the transition

Based on the results of this study, a positioning of the investors on the niche level, where they financially support radical innovations to eventually move from the existing regime to a new one can be ruled out. This is because too few investments could be found that went into practices that could destabilize the system. Instead, most of them were rather incremental changes picked up and financially optimized by incumbents.

However, there are some signs that could support that the investors actually did consider more than risk-adjusted returns and tried to be active participants in the transition. As aforementioned, it appears that especially businesses are still in the early stages of transforming their BMs towards more circularity (Kirchherr et al., 2018; Stumpf et al., 2021). To better understand the transitional stage a company is currently in, the framework by Chen et al. (2020) was presented early in this thesis (see Table 1).

The fact that apart from some exceptions, all the analyzed companies have some kind of CEBM implemented in their business could indicate that these firms are in the second stage of the transition, currently testing the feasibility of CEBM on a smaller scale. This would be in line with the findings of Stumpf et al. (2021), who did not find many radical changes in their

analysis of 131 CEBM but argue that the companies were still in the experimentation phase of how CE practices can be implemented in their businesses. Furthermore, they argue that the companies are preparing for a possible shift towards a CE to be able to eventually climb up the R-ladder (Stumpf et al., 2021).

A similar argumentation could be made for this study as a majority of the CEBM and design strategies were implemented on a 'selected product' level which would support that those companies are in the second stage currently experimenting with the circularity practices. Moreover, a relatively high share of investments went into repair/maintenance and refurbishment BMs (combined 27%). These are especially crucial when it comes to the implementation of PSS, where the focal company stays the owner of a product and must keep it in shape to be able to use it as long as possible. Thus, these measures could serve as enablers in the transition to the more circular PSS and help the companies to climb up the R-ladder at a later period in time in the transitioning process (Potting et al., 2017; Seles et al., 2022; Tukker, 2015).

Furthermore, even though incumbents are traditionally considered as an opposing force in a transition, they can also bear the role of a supporter. This applies, for example, when they are trying to diversify their business strategy to take advantage of new developments (Fischer & Newig, 2016). Here, too, parallels can be observed with the analyzed companies, as a majority of them have integrated circular economy practices in at least parts of their business models. With this diversification of their BMs, they could aim to benefit from the CE transition and serve as a supporting actor. In this case, the companies would appear as 'greening Goliaths', which establish circularity practices on a mass market. This makes them more accessible for a wider variety of consumers and thus contributes to the transition (Hockerts & Wüstenhagen, 2010). This can be seen in many of the aforementioned examples. For instance, Coca Cola and the Ball cooperation offering recycled and recyclable packaging; Dell, Caterpillar and Cummins offering refurbished products; L'Oréal offering long lasting and reusable packaging; or signify offering light as a service.

If it is assumed that the companies the funds invest in are in the second stage of the transition, experimenting with the implementation of different circularity practices and eventually being a supporter of the transition, one could argue that the respective investors are in the same stage of the transition. Each of the funds belongs to big asset managers like Black Rock which manage a variety of different other funds and that can be considered as

regime actors (Nykvist & Maltais, 2022). For each of the investors, the fund is the only one with a particular circularity focus, and also generally speaking the emergence of circularity in finance is a rather novel trend (Ellen MacArthur Foundation, 2020).

However, the existence of these funds shows that the investors have recognized the problems of the linear system (stage 1 of the concept by Chen et al. (2020)) and are now experimenting with the feasibility of investments in the CE on a smaller scale. This would also mean that there is an open window in the regime for change since not only the institutional investors but also the incumbent companies they invest in – both players that are well-established in the current system and so far mainly engaged in the linear economy (Kirchherr et al., 2018; Nykvist & Maltais, 2022; Reike et al., 2018; Stewart & Niero, 2018) - made a first move towards a CE.

Furthermore, the fact that the investors have invested in those companies under the premise that they are engaged in the CE could be understood as a sign of a paradigm shift of investors not only being interested in maximizing returns but also considering additional aspects like the ability of a company to support a transition to a circular system. In fact, such a paradigm shift could be rooted in a change in the landscape (e.g., changed consumer interests; policies like the EU Green Deal) (Nykvist & Maltais, 2022). This would have striking consequences as investors could exploit their potential to influence the trajectory of the transition by providing capital to new technologies and practices that are beneficial for the transition (Geddes & Schmidt, 2020; Mazzucato, 2013). Consequently, instead of extracting value they would create value, that is beneficial for the circularity transition by providing capital to supporting companies (Mazzucato, 2013).

To sum up, the investigated funds all belong to relatively big asset-managing organizations, which are usually known for being rather risk averse and investing in incumbent companies which are traditionally part of the regime. The results of this study, however, show some signs that could be interpreted in a way that those companies are experimenting with their currently 'lower' circularity strategies to eventually climb up the R-ladder and become supporters of the circularity transition (Geddes & Schmidt, 2020; Stumpf et al., 2021). Such a transition requires capital, and since the funds claim to invest in those companies because they are committed to circularity practices (see Appendix IV), it can be argued that they are actively trying to foster the transition with their investments in those 'greening Goliaths' (Hockerts & Wüstenhagen, 2010).

This argumentation may sound logical, but it also entails some limitations. Therefore, in the following, a second perspective on the role of the investors will be discussed, which sees the investors rather as value extractors than creators (Mazzucato, 2013).

The value extracting perspective

As argued before, both the investors and the firms under investigation may be positioned in the second stage of the transitioning process. However, for the transition to successfully happen, this would also mean that at some point, they would have to move on to the next stage of the process by implementing more radical changes on a wider scale to prove that they actually serve as an active player in this transition (Hockerts & Wüstenhagen, 2010). Since both of the actors are regime players it is questionable to what extent this will happen in the future as such actors tend to adopt to changes along predictable trajectories to stabilize the existing system instead of challenging it (Geels, 2010).

In the case of the CE transition, it has already been observed that incumbents tend to implement rather less radical circularity practices (Henry et al., 2020; Stewart & Niero, 2018). Furthermore, financial regime actors are usually known for prioritizing risk-adjusted returns over, e.g., sustainability aspects (Nykvist & Maltais, 2022). Hence, there is a high uncertainty as to what extent they will be an active driver in the transition to a CE as long as the linear economy is still the dominant system where more radical circularity practices are considered to be rather risky (Aranda-Usón et al., 2019).

These limitations open the debate for another rather passive role of the financial actors in the transition. First, it must be mentioned that only a few signs have been found that indicate a destabilization or comprehensive replacement of the current regime. Instead, most of the implemented practices are rather incremental and/or appear in addition to the existing structures. For example, 80% of the investments went into practices that were applied on ‘selected products’, ‘packaging’, or ‘by-products’. In comparison, only 20% of the companies have circularity practices in place that affect their entire BM. Consequently, there is no replacement of the existing linear structures, but they have been supplemented by the circular strategies.

Furthermore, as shown before, recycling practices are less transformative innovations compared to, e.g., PSS as less systematic change is required, and they can be rather considered as product optimizations/adjustments. The same applies for maintenance/repairing strategies as they do not really entail bigger social/cultural changes (Stumpf et al., 2021). According to

Hörisch (2018), such activities can either be categorized as an optimization or a reconfiguration pathway of a transition (see table 2). The problem with both of pathways from a transition perspective is that they do not entail a radical change or a replacement of the existing regime. In fact, regime actors like incumbents serve as gatekeepers deciding which innovations can enter the system, sometimes even to stabilize it (Hörisch, 2018).

Finance could contribute to this process. As previous studies have shown, the financial sector has an influence on the development of innovation and is also considered a crucial aspect in the transition for companies towards more circularity (de la Cuesta-González & Morales-García, 2022; Mazzucato, 2013; Rizos et al., 2016). On the other hand, financial actors are seeking for risk-adjusted returns whereby bigger investors, which invest in established companies are known to be particularly risk averse (Mazzucato, 2013; Nykvist & Maltais, 2022).

As a consequence, there are certain interdependencies between those two players. Incumbents, especially when they are listed on a stock market as the ones in this study, are interested in increasing the value of their stocks. The investors that buy their stocks, however, are rather risk averse. Hence, incumbents are not incentivized to make risky decisions like making significant investments in radical but uncertain innovations, as they might make them less attractive for investors (Mazzucato, 2013). As a result, and contradictory to the argumentation of the first perspective, the investors rather support incremental changes due to their aversion to risks instead of facilitating the transition.

Another argument that could support why the investors' role shows characteristics of a regime actor lies in their general goal of their investments. As the discussion of the results above has shown, a main reason for the implementation of the most occurring circularity practices in the analysis was cost efficiency. For example, the high share of repairing, maintenance and refurbishing practices were explained by their relatively low up-front investments as downstream activities with an active consumer involvement. Also, the more than 30% of reducing practices within the design strategies, which are highly ranked in the R-ladder, become less surprising if they are explained by efficiency measures that lead to cost reductions for the focal companies. Furthermore, recycling, the main practice that was found, is mainly implemented in companies for profitability reasons (Salvador et al., 2020).

These findings are align with the study of Ranta et al. (2018) who showed in their research that cost efficiencies are the main driver for a company to implement circularity

practices. As a result, they argue that the implementation of a CEBM must provide an economic value to be able to compete with the current linear system and thus to be attractive for a company. Since most of the companies still operate in a linear system, it is easier to adjust the existing BM instead of creating a new one (Diaz Lopez et al., 2019). Especially when having in mind that many customers do not seem to be ready yet for a 'cultural' shift towards more radical circularity practices (Kirchherr et al., 2018). Consequently, a recycling BM is more likely to compete against a linear model than a more radical CEBM, which is, for instance, based on a PSS and requires a socio-institutional change.

From a finance perspective, the argumentation that the implementation of CE practices is determined by their ability to generate profits confirms the findings of Nykvist & Maltais (2022) that there is no shift from risk-adjusted returns and that those are still prioritized over environmental and social aspects. This would explain the high share of investments that went into recycling practices, as these are generally the least risky and bear the potential to bring new returns in from of lower material prices or new revenue streams (Ranta et al., 2018; Stumpf et al., 2021). This would mean that these investments were mainly made for one reason: because they are financially attractive.

However, such a narrow focus on risk-adjusted returns can be, from a transition perspective, rather dangerous if the main goal is achieving a sustainable development. More generally speaking, the CE still lacks a clear conceptualization. While some see in it a great opportunity for a systematic change towards a new economic system that creates environmental, social, and economic value, others prioritize the growth opportunities the concepts promises to be able to exploit, while sustainability aspects are only considered of secondary importance (Reike et al., 2018). Especially the latter view of the concept is problematic, as not every circularity practice brings along a sustainability impact. For example, a refurbishment process that requires a lot of energy might have a bigger environmental footprint than producing a new product in an eco-friendly way (Kevin van Langen et al., 2021; Palmié et al., 2021; Salvador et al., 2020). Therefore, if businesses and investors have a too strong focus on the economic benefits of the CE and neglect the environmental and social ones, there is a high risk that its implementation will not address the roots of the persistent problems. Instead, the change will be rather incremental, adjusting the current business logic that represent a weak sustainability approach (Hofmann, 2019).

For the role of investors in the CE transition, this would entail that they are not to be expected to be an active driver in the CE transition. As argued by Nykvist & Maltais (2022) they would only act as an enabler if circular investments become economically attractive for them.

Finally, besides these aspects, the assessment tools investors use to rate the performance of the companies they invest in play a crucial role in their role in the circularity transition. In fact, most investors usually still use their traditional assessment criteria which, were developed for BM of the linear economy to analyze CEBM. However, these tools have a high tendency to assess CEBM as too risky as they are not adjusted to the changed requirements of the CE (Achterberg, 2021; Circle Economy, 2022; de la Cuesta-González & Morales-García, 2022). For example, there are certain intangibles like a reduced company risk or less raw material price volatility which are of high importance for a company when implementing a CEBM. Despite their relevance for circular businesses, the traditional assessment tools of the investors often fail to capture these intangibles (de la Cuesta-González & Morales-García, 2022). Furthermore, residual resources, which also have a high relevance in the CE, are currently not sufficiently considered in traditional accounting, which makes them invisible to investors (Circle Economy, 2022).

In addition, as aforementioned, the fact that CEBM are assessed as too risky especially applies to PSS as those BMs require high upfront investments in assets by a company which are considered with costs in existing accounting tools (Achterberg, 2021; Aranda-Usón et al., 2019; Potting et al., 2017).

The fact that the investors still use their conservative linear assessment tools for analyzing CEBMs is of such high relevance for their role in the CE transition as they influence what is being financed (Geddes & Schmidt, 2020; Mazzucato, 2013). The discussion above has shown that there is a high likelihood that most of the investments were made because they promise an appropriate ratio of risk and return. Consequently, circularity practices that were considered less in the investments (e.g., PSS) must have been assessed as not offering a sufficient risk and return ratio.

An investor analyzing a CEBM against the criteria of a linear BM will most likely invest in businesses that are expected to be successful in the current system. These businesses, however, will not bring a radical change in the system but rather stabilize it, while more radical innovations like PSS that require a socio-technical change are considered as too risky. Moreover, the missing willingness of investors to re-think their current assessment tools to

analyze CEBM can be understood as resistance to radical change as they rather adjust the current system, which they are benefiting from, instead of changing it.

5.2 Discussion of RQ2.1 and RQ2.2

In the following section, the results of RQ2 will be discussed based on the findings of the interviews. First, the incentives and motivations of the VC to invest in circular start-ups will be analyzed. Second, it will be discussed what these incentives and motivations mean for their role in the circularity transition.

5.2.1 The VCs' incentives and motivations

The findings provide several insights into the incentives and motivations of VCs to invest in circular start-ups. Among the primary motivations for investing in these start-ups is the potential to generate profits. This determines the VCs' investment decisions as they monitor possible investment targets regarding their potential to generate a certain return. Therefore, the 'success' of a VC investment (whether with a circularity focus or not) is determined by gaining a sufficient return on investment (Bocken, 2015; Gaddy et al., 2017; Randjelovic et al., 2003). The way VCs create those profits is by selling their positions when the investee goes public, merges, or is acquired by industry incumbents (Holtslag et al., 2021). As a consequence, VCs are incentivized to invest in companies that promise a very high return within the designated time frame of 10 years (Bocken, 2015; Gaddy et al., 2017).

An important observation in this is that VCs, despite a sustainability focus, are still subject to the classical VC investment criteria. A crucial role in this play the VCs' own investors (limited partners) who are coupling their investments to certain requirements which the VCs have to comply to. Those requirements include, for example, that the VCs must pay back a return after the time horizon of 10 years. Thus, these requirements are rather conservative and dominated by the neoclassical economic thinking of profit maximization (Mähönen, 2018). Furthermore, the importance of their own investors is underscored by the findings that show that attracting capital becomes significantly more difficult for VCs if they do not meet their requirements.

Besides the focus on generating profits, it obviously cannot be neglected that VCs investing in CE start-ups also assess their investment targets against comprehensive sustainability criteria. As argued before, the fact that VCs base their investment decisions on the potential of a start-up to generate profits can be seen as an indicator of their financially

driven motivation. On the other hand, the sustainability performance of their investment targets is an equally important investment criteria, and they are aiming to balance financial profits with sustainable impacts. Hence, one could conclude that achieving sustainability through establishing sustainable companies on a mass market is the second main motivation of VCs investing in the CE.

However, this is only conditionally the case since the sustainability contributions are restricted to the conditions of their own investors. As the findings revealed, one of the main barriers to investing more in circular start-ups is the time horizon of their investments which is considered as too short since many interesting circular technologies need more development time for commercialization. As aforementioned, these time horizons are requirements set by their own investors, who do not seem to be willing to change their standards for more circular investments (Heeb et al., 2021). This is a central finding because it underlines the VCs' dependency on their own investors and their rather conservative economic thinking. Even if the VCs were willing to make investments that are longer than ten years and that prioritize circularity over profit, they would not be able to do so as they must comply with their own investors' rules to attract capital.

Consequently, the identified goal to contribute to a SD can be interpreted as a goal of the VC fund as they condition their investments to strict sustainability criteria. However, this motivation is very restricted to the requirements of their own investors, who are more interested in financial returns and who seem to view circularity as a market opportunity but do not seem to be willing to change their standards (Heeb et al., 2021; Mähönen, 2018; Nykvist & Maltais, 2022). Hence, it can be argued that the VCs' incentives and motivations to invest in circular start-ups lies in the generation of risk-adjusted returns for their own investors, who are limiting the VCs' motivation to contribute to a SD.

5.2.2 The role of the VCs in the circularity/sustainability transition

In the results, the VCs have been presented as enablers for growth in start-ups which makes them contributors to the CE transition. With the background of their previously discussed incentives and motivations, the following section discusses the VCs' role as those enablers based on the existing literature.

As shown in the theoretical framework, start-ups can play an active role as niche players in a transition. As 'emerging Davids,' they develop novel solutions that do not only aim to generate a financial profit but also a social and/or environmental value (Hockerts &

Wüstenhagen, 2010). A big advantage of these start-ups is that they can experiment with new solutions in their niche without being influenced by the practices of the regime. If they eventually manage to leave their niche and enter the regime, they can increase their impact by providing sustainable alternatives to the current practices of the regime actors and establish new market standards (Hockerts & Wüstenhagen, 2010; Holtslag et al., 2021).

However, to develop as a venture that provides new cost-effective and sustainable market solutions, a start-up requires capital to grow. Investing in start-ups is usually considered very risky, and investors seeking for risk-adjusted returns are often not willing to take this risk (Geddes & Schmidt, 2020; Moore & Wüstenhagen, 2004; Nykvist & Maltais, 2022). Consequently, the emerging Davids need courageous and bold investors that are not too attached to establish market incumbents (Geddes & Schmidt, 2020; Perez, 2003). VCs, who are known for having a high risk-tolerance, invest in those start-ups which are not attractive investment targets for other investors (Gaddy et al., 2017). Consequently, VCs can play an essential role in a transition through financing promising circular solutions which would otherwise not receive funding (Bocken, 2015; Holtslag et al., 2021).

While the literature has recognized the significance of start-ups as key players in the transition, studies that further conceptualized this role called for a more nuanced perspective. Gibbs and O'Neill (2014), as well as Hörisch (2015) argue that there are different types of entrepreneurs who vary in their ability to influence a transition. Especially in the sustainability field, some start-ups develop novelties that are so opposing to the existing dominant system that they do not want to reach a mass market. This is because they fear to lose their radical approach in the process of entering the regime level, for example, by increasingly focusing on economic aspects instead of environmental or social ones (Gibbs & O'Neill, 2014). A similar argumentation could be made for the CE where start-ups that radically oppose the linear system might not be willing to give up on their degree of circularity for more significant shares on the mass market and, thus rather stay in their niche. However, from a transition point of view, such start-ups are not expected to have a significant influence on the transformation as their novelties are only picked up on a irrelevant degree (Hörisch, 2015).

On the contrary, it needs start-ups that provide innovative circular solutions and that are able and willing to offer them on a mass market. Therefore, a balance between a market effect and a CE effect must be given so that the start-up actually has an influence on the transition. While the market effect refers to the ability of the start-ups to offer their products

on a mass market to replace comparatively linear solutions, the CE effect means providing a positive effect on the overall CE transition (Hörisch, 2015).

This is where VCs can play a crucial role and exert influence during the transition. Their evaluation criteria are geared towards identifying startups with the potential to achieve significant growth and establish themselves in the mass market. As a result, they seek out those start-ups that have a substantial market effect. Additionally, although their assessment criteria may not explicitly include circularity aspects, they do prioritize the sustainability performance of the companies they consider. As a result, they ensure that the circular start-ups they invest in actively contribute to the sustainability aspect of the CE transition.

Consequently, the VCs' investment targets strike a balance between the market effect and the positive contribution to the CE, positioning them as promising actors for the overall transition.

Furthermore, the impact VCs can have on the development of those start-ups has been further investigated in the literature. For instance, it was shown that VC financing has a positive impact on the performance of a start-up (Kang, 2020), and it is argued that their engagement is essential for technology innovations in these firms (Maiti, 2022). Oftentimes, the VCs' support goes beyond the provision of capital (Holtslag et al., 2021). Moore & Wüstenhagen (2004), describe their role as 'coaches and partners' that accelerate and shape the development of a start-up in an early stage. For instance, they share their particular competence and techniques of corporate environmental management, contribute to a faster professionalization and help start-ups develop a strong business case while creating a positive impact on society and the environment (Bocken, 2015; Moore & Wüstenhagen, 2004; Randjelovic et al., 2003). A similar role of the VCs providing stewardship for their investees was also found in the results.

Moreover, VCs are usually specialized on a certain industry and have the knowledge and network to understand the needs in a specific field. Thus, they have a forecasting role as they anticipate the future demand for sustainable products. Moreover, through financing start-ups that meet this demand, they help them to establish on a mass market (Holtslag et al., 2021).

Furthermore, a study by Maiti (2022) has shown that the development in venture capital investments leads to greener growth (Dhayal et al., 2023). Therefore, Bocken (2015) even extends the argumentation that VCs serve as enablers in the transition through providing

capital and stewardship and sees them as 'gatekeepers' who actively select the emergence of new businesses.

Lastly, the interviewees' argumentation that they encourage conventional investors to make more investments into the CE by proving their profitability has also been found in the literature. Bocken (2015) argues that VCs with a sustainability focus have the ability to demonstrate that sustainable business is good business, and their investments can serve as catalysts for conventional VCs to move into the sustainability space. Considering that the CE is seen as a concept to achieve a sustainable development, a similar argumentation can be made for the VCs investing in circular start-ups. Convincing conventional investors to steer away their investments from unsustainable linear practices is particularly important since traditional sources of finance are considered insufficient to promote novel sustainable business (Dhayal et al., 2023; Geddes & Schmidt, 2020).

In addition, it has been found that traditional VCs that invest in sustainable start-ups do not consider sustainability aspects in their investment criteria and decision-making (Wöhler & Haase, 2022). From a CE transition perspective, this can be problematic as it can negatively influence the sustainability performance through side effects like burden shifting or rebound effects (Kevin van Langen et al., 2021). If the VCs invest in circular start-ups without comprehensively assessing the sustainability performance of the firms, there is a chance that they invest in practices that do not address the required change towards more sustainability. This was also shown in the leather example presented in the results.

To sum up, the discussion has provided supporting arguments from the literature that confirm the role of VCs in the CE transition presented in the results. It has been shown that the literature emphasizes the role of sustainable start-ups in the transition as well as shows that VCs play an active role in successfully developing those start-ups for the mass market, where they can lead to green growth. In this scenario, they can be described as gatekeepers deciding which start-ups are being financed to have a chance to leave the niche and enter the regime. Moreover, the argumentation that VCs can catalyze sustainable investments by proving their profitability was also legitimized by the existing literature.

The limited role of VC in the transition

While it can be argued that VCs play an active role as enablers in the transition, some literature provides arguments that show limitations of this perspective. In particular, it can be argued that the VCs are not able/willing to finance all start-ups and technologies that would be

needed for the transition due to their focus on risk-adjusted returns and the specific characteristics of the companies, which do not conform with the investment criteria of the VCs. Indicators that support this can be found in several aspects within the results of the interviews.

Having a closer look at the barriers identified in the results which hinder VCs from investing in circular start-ups, it can be seen that most of them refer to the risk profile of their (potential) investments, which are in the CE field often too high. For example, it was stated that the potential investment targets often have some type of deficiency which reduces the expected profitability of the start-ups.

To put these results into perspective, it is worth it to have a closer look on how VCs typically work. Like most other investments too, VC investments are based on their risk/return ratio. That means that investors will decide whether they take action or not according to the expected risks and returns of an investment. Only if an investment displays a pre-determined risk-return ratio that is within desirable limits, the investor will invest. Moreover, it is generally assumed that potential returns rise only by accepting increased risks. (Geddes & Schmidt, 2020).

VCs are willing to take a very high risk as they invest in new technologies which have not yet proven to be successful on the market, and there is a high chance that those investments will end up as losses (Geddes & Schmidt, 2020; Moore & Wüstenhagen, 2004). Hence, VCs usually follow a portfolio approach where they invest in a variety of start-ups, knowing that some of them will probably not bring any returns (one interviewee stated that out of 10 investments, they expect 6 not to work out). Therefore, those investments that are profitable have to generate such a high return that it covers the losses of the failed investments and even generates a profit on top (Gaddy et al., 2017; Maiti, 2022). Consequently, VCs are incentivized to pick companies from high-growth markets that have the potential to return 10–100 times the amount invested (Gaddy et al., 2017).

These dominant structures raise the question to what extent VCs are the ideal fit to provide finance in a circularity transition. Circular technologies are very capital intensive, have a high technology risk profile, and need long development horizons (de la Cuesta-González & Morales-García, 2022; Mähönen, 2018). This contradicts the short-term mindset of the VCs (investment horizon of ten years), and the capital intensity of the investments makes it difficult to achieve a sufficiently high enough return. (Bocken, 2015; Hegeman & Sørheim, 2021;

Mähönen, 2018; Maiti, 2022; Mazzucato, 2013; Polzin, 2017). Consequently, potential investments are often outside of the desired risk return-ratio –which was also observed in the results as start-ups were often considered to be not profitable enough. Thus, compared to other industries, CE related technologies are for VCs more challenging to finance. A study by Gaddy et al. (2017), for instance, has shown that cleantech investments pose higher risks and yield lower returns for VCs than investments in software related technologies. And indeed, software investments, in which VCs had their first big success, seem to be way more fitting for VC investments as they are faster to develop and can be scaled up more easily compared to asset-heavy technologies for the CE transformation (Geels, 2013; Moore & Wüstenhagen, 2004).

The fact that the risk and return ratio determines the investment decisions of the VCs significantly influences their role in the circularity transition. As argued before, VCs can play an active role in the transition if they invest in circular start-ups, and placing sustainability at the center of the assessment of these businesses can promote green growth in the CE (Maiti, 2022). On the other hand, it was shown that even though VCs base their investment decision on sustainability criteria, they also reject investments that are not in their desired risk return-ratio. In other words, VCs unselect those start-ups which are either considered too risky or which do not yield the expected returns, even though, they potentially could have a great impact on the CE transition (Geddes & Schmidt, 2020).

As aforementioned, one could argue now that this makes sense even from a transition perspective since companies that do not have the potential to survive on a mass market will not be able to have an influence on the regime either (Gibbs & O'Neill, 2014). However, as the discussion of the VCs' motivations has shown, VCs not only assess start-ups according to their ability to generate profits on bigger markets but also to the requirements of their own investors. This applies especially to the time horizon of the investments, which was identified as a barrier for CE investments (Bocken, 2015; Mazzucato, 2013). More patient investors would give the VCs the opportunity to invest in technologies that require longer development times and establishing them on a market where they potentially have an influence on the transition while still generating a profit.

Besides the VCs' own investors, incumbents can be a second actor that has an influence on the role of the VCs in the transition. In the results, incumbents were identified as drivers for VCs' investments as they are demanding circular solutions. Moreover, VCs often either aim

to sell their investment shares to incumbents through acquisition or invest in start-ups that have a potential to sell their products/solutions to existing market actors (Bocken, 2015; Holtslag et al., 2021). In this case, incumbents can even be a barrier as they set specific requirements which are difficult to achieve with the start-ups (Bocken, 2015). These were identified as structural barriers in the results.

More generally, incumbents that are engaged in venture capitalism themselves often follow a strategic goal that entails positioning themselves as 'green' on the market by exploring and investing in sustainable start-ups. This includes learning from the start-ups' green technology to green their own business or opening a window for new markets (Hegeman & Sørheim, 2021). If VCs select (or unselect) start-ups according to their ability to create value for incumbent companies, a radical change is not likely to happen through these investments due to the incumbents' resistance to change (Geels, 2010; Hörisch, 2015). Such investments are more likely to be an optimization or reconfiguration pathway, according to Hörisch (2018).

In the course of the optimization pathway, no regime replacement takes place since incumbents only adopt certain niche practices to lower the pressure from the landscape. However, a stud by Hörisch (2018) has shown that a transitional change can occur through the reconfiguration pathway. In this case, incumbents pick up niche innovations to a relatively large extent, which does not lead to a replacement of the entire regime, but the development of new structures which bring substantial changes on a larger scope (e.g., an industry).

However, it must be emphasized that not all interviewees claimed to aim to cooperate with incumbents. Others explicitly stated that they want to develop companies that establish as big players in the mass market. In this case, the potential to destabilize the existing regime and/or replace regime actors/practices is higher as they might be more independent from incumbents. This would mean that the VCs investing in those start-ups have the potential to support a transformative pathway in the transition.

In summary, the discussion highlights that VC investments are primarily driven by specific characteristics such as high risk, growth potential, and a limited investment horizon of around ten years. However, these characteristics do not align well with the nature of many circularity investments, which often require longer development times and significant capital investments. Additionally, the influence of VCs' own investors and incumbents is a noteworthy factor. As gatekeepers between the niche and the regime, the impact of these investors becomes apparent, as it restricts the VCs' role in promoting radical change. Instead, VCs tend

to select investments that align with the preferences of their investors and incumbents, who can be considered as being part of the existing regime.

Overall, these factors limit the ability of VCs to drive transformative change in the circularity transition, as they are guided by criteria that prioritize the interests of their investors and incumbents rather than pushing for disruptive solutions.

6. Conclusion

This study aimed to contribute to the emerging debate on the role of finance in the CE transition. To do so, two different financial actors investing in different firms by size were examined through the lens of the MLP. First, large public equity investors managing investment funds with a particular focus on the CE. These investors finance incumbent companies, and they can be situated in the regime (Nykvist & Maltais, 2022). On the other hand, venture capitalists investing in start-ups which can be either part of the niche or regime level (Gibbs & O'Neill, 2014; Hörisch, 2015). Therefore, the VCs' position within the MLP is not as clear and was further investigated in this thesis.

To analyze the role of the public equity funds the BMs they invest in were analyzed based on a content analysis. The aim was to determine the type of CEBMs and circular design strategies the investors invest in. Based on the results of the content analysis, two different possible roles of the investors managing the investigated funds in the transition have been discussed. The first perspective saw the investors as active enablers of change. It was argued that their particular focus on companies that are engaged in the CE can be understood as a first step towards supporting companies that eventually will have the ability to reach higher levels on the R-ladder and, by doing so, foster the CE transition. Moreover, it was assumed that the investors actively consider circularity practices and that they show an interest in the transition.

This perspective shows that the CE transition has already reached the regime through regime actors adopting CE practices. Furthermore, it provides a potential scenario of how the investors can contribute to the CE transition through their current investments.

The second perspective has seen the investors as classical regime actors who are less interested in the transition aspect but more in making risk-adjusted returns. This argumentation has been supported by the fact that the investments went into incremental practices instead of the destabilization of the current system as well as incumbents which are

traditionally not known for being drivers for radical change. Furthermore, a radical change requires the replacement of the existing regime and the introduction of new habits, standards, norms, and practices as part of strategies to change the system context (Gibbs & O'Neill, 2014). In the case of the investors, however, there are no signs that they have changed their established standards and norms. Instead, they still seem to be driven by making risk-adjusted returns and usinf their traditional assessment criteria, which were developed for the linear economy.

To answer RQ1.2 both, of the perspectives are represented in the role of the investors in the transition. The fact that big asset managers like the ones analyzed have investment funds with a circularity focus in their portfolio shows that there is a general interest in the CE by finance. Additionally, almost all the companies within those funds actually did implement CE practices which shows that the assessment of the investors most likely included the circularity performance of the focal companies. Against the background of Hockerts & Wüstenhagen's (2010) work, this can be a promising prospect from a transition perspective as the investors support greening Goliaths which, are required for a successful transition (Hörisch, 2015).

However, it remains to be seen which type of transitional pathway the investors will support in the future. As argued in previous studies too, this thesis showed that the investors are still predominantly following orthodox economic thinking. This includes especially the conventional assessment criteria which focus on the quantitative aspects like generating risk adjusted-returns (Nykvist & Maltais, 2022). Moreover, these criteria were developed for the linear economy. Applying them to the CE transition means that the change is influenced by principles of the existing linear system, which has an influence on the trajectory of the transition (Naidoo, 2020) and leads to path-dependencies around investments that stabilize the linear economy. Hence, a transformative pathway resulting in a regime replacement is not supported. Instead, the investors currently finance an optimization or reconfiguration pathway (Hörisch, 2018).

These findings must be seen in the light of some limitations. A transition is a non-linear iterative process that affects a system on different levels. This thesis, however, only focused on certain actors in such a transition. Hence, the generalizability of the results is limited. For example, the results of the content analysis rather represent a snapshot of what is currently being financed by the investigated investors. However, other funds may invest in different CE

practices. Moreover, the funds may change what they are financing in the course of the transition. Consequently, the results show a trend in what large investors currently consider as attractive investment targets within the concept of the CE, but they do not indicate the general direction the CE transition is currently taking.

To investigate the role of the VCs in the CE transition, semi-structured interviews were conducted. The aim was to find out about their incentives and motivations to invest in circular start-ups. It has been shown that despite a clear interest in contributing to a SD, the VCs are also influenced by conventional investment criteria, which is limiting their role of being an active enabler of a transformative transition pathway. Here as well, two perspectives on the role of the VCs in the transition have been discussed.

On the one hand, VCs have the ability to influence sustainable change on a regime level through investing in emerging Davids (circular start-ups) and establishing them on the mass market. Unlike other investors, they are willing to take high-risk investments which are needed in a transition to bring promising start-ups from the niche into the regime. Simultaneously, VCs are seeking for high returns and start-ups that contribute to a regime replacement, e.g., through a disruptive technology that can be expected to generate such returns. Moreover, the VCs use comprehensive sustainability criteria, which promise to ensure the needed environmental and social change when the circular start-ups they invest in make it to the mass market.

However, this thesis has also shown that VCs operate under the influences of certain regime actors, which substantially affect their investment decisions. Notably, their own investors determine investment criteria, which are geared towards achieving quick profits. This is against the nature of many circular solutions, which require high up-front investments and long development times. In fact, the VCs can be considered as one of the first serious interactions between the start-ups as niche players and the standards of the regime. While in their niche, start-ups can usually operate independently from the pressure of the regime, once they want to receive VC funding, they have to fit and conform to those standards to enter the regime (Geddes & Schmidt, 2020). Hence, a transformative transition pathway supported by the VCs is rather unlikely. Instead, VCs can be seen as intermediaries between the regime and the niche, having the ability to select which start-ups can enter the regime, however, under the conditions of certain regime actors.

Thus, the role of the VCs in the transition can be very crucial. While it has been acknowledged that start-ups can be important contributors to a transition, they cannot shift their novelties into the regime all alone. Rather, they require the support of additional actors that provide translation between the niche and the regime. This is particularly important when the novelties from the niche oppose the current regime (Gibbs & O'Neill, 2014; Hörisch, 2015) – such as the CE practices oppose the prevailing linear system. Therefore, by introducing some of the regime rules to the start-ups, the VCs can support them in establishing their circular practices on the regime level and thus accelerate the transition.

This part of the research also inherits some limitations. Regarding the interviews conducted with employees of VC funds, it must be considered that only a limited number of informants were interviewed. VCs, however, typically follow an individual investment strategy which may influence their role in the transition. For instance, when it came to the determination of CE practices that were considered particularly interesting, the results might have varied with different interview partners. Moreover, only interview partners that work for VCs with a sustainability focus were interviewed. This could result in biased answers, for example, when it comes to the perceived contribution to a CE as personal goals or values contradict the principles of the VC funds.

To answer the main research question of this study, how different investors by size contribute to the CE transition, the results of this thesis are put in the light of the framework of Hockerts & Wüstenhagen, (2010). It has been shown that both, large public equity funds, as well as smaller VC funds can contribute to the circularity transition through supporting greening Goliaths and emerging Davids (Hockerts & Wüstenhagen, 2010). In the context of this transition, the greening Goliaths financed by the larger investment funds have currently implemented rather incremental changes. This was to be expected as they are still successfully operating in a predominantly linear system. One way to adopt more radical changes by those incumbents is by picking-up novelties developed by niche actors such as start-ups (Hockerts & Wüstenhagen, 2010; Hörisch, 2015). Those are financed by VCs which consequently play a crucial role in the transition as they support the required start-ups entering the sphere of the regime and connect the two different levels (Hörisch, 2015).

However, this thesis has also shown that the VCs are influenced by the rules of the regime. This means that if the incumbents adopt the innovations of those start-ups financed by VCs, they pick up practices that were already filtered by some of the standards of the

regime. Consequently, the transition supported by the financial actors follows a certain path influenced by the rules of the regime, which will most likely hinder a transformative radical change. Since these rules are mainly related to the standards of orthodox finance and refer to achieving risk-adjusted returns, it needs policy interventions that make circular solutions financially more attractive for finance to become an active driver in the transition (Geddes & Schmidt, 2020; Naidoo, 2020; Nykvist & Maltais, 2022)

This thesis contributes to the existing but still embryonic field of research on the role of finance in transition studies, particularly by focusing on the MLP. It builds up on the existing literature in several aspects. For example, it illustrates how two different financial actors by size can contribute to Hockerts & Wüstenhagen's, (2010) framework of greening Goliaths and emerging Davids. Moreover, it strengthens the argumentation of positioning finance in or close to the regime (Geddes & Schmidt, 2020; Geels, 2013) and emphasizes the need for new standards that put more focus on circular aspects in the assessment criteria of financial actors (de la Cuesta-González & Morales-García, 2022; Naidoo, 2020).

To better understand which transitional pathway finance is supporting, future research should further investigate how finance is contributing to the CE transition. With this thesis, it could be stated that both financial actors studied are not likely to support a transformative pathway. However, there were no clear signs whether they invest in the optimization or reconfiguration path. This is because the CE transition is still in the beginning, and it is not clear if the current linear regime adopts circular practices to stabilize its position or implement them as serious alternatives next to their existing products/practices. To be able to draw this conclusion, the transition needs to be further advanced, and it requires a more holistic research approach that takes a system perspective (e.g., similar to Hörisch (2018)).

To influence the trajectory of the transition and avoid an optimization pathway, practitioners should consider steering more capital in the desired direction of the CE transition. This is especially important as this thesis has shown that investors are influenced by orthodox economic thinking like profit maximization. As argued earlier in this thesis, the CE still lacks a common conceptualization, and different stakeholders vary in their understanding of the concept. This bears the risk that economic actors like the investors influence the transition through their behavior in a way that the concept becomes an economic system that is still embedded in the neo-liberal paradigms of creating value for shareholders instead of actively incorporating ecological and social aspects.

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Appendix I

Table 8

Conceptualization of circular design strategies. The table was used as a coding manual for the content analysis

Strategy	Categorization	Explanation	Assessment criteria	Reverse cycle	Source
Slowing loops					
Designing long life products	Design for attachment and trust	The creation of products that will be loved, liked or trusted longer.	The company offers products that are meant to be loved, liked and trusted longer.	Reduce	Bocken et al. (2016)
	Design for reliability and durability	Durability relates to physical durability, for example, the development of products that can take wear and tear without breaking down. Material selection for durability is an important part of the design process.	The company offers products that can take, wear and tear without breaking for example through the selection of durable materials.	Reduce	Bocken et al. (2016)
		Reliability refers to designing for a high likelihood that a product will operate throughout a specified period without experiencing a chargeable failure, when maintained in accordance with the manufacturer's instructions. Product testing to	The company offers products with a high like hood of operating without experiencing a chargeable failure.	Reduce	Bocken et al. (2016)

		mimic normal use can help test the reliability of the product.			
Design for product-life extension	Design for ease of maintenance and repair	Maintenance is the performance of inspection and/or servicing tasks (technical, administrative, and managerial) to retain the functional capabilities of a product.	The company is offering products that can retain its functional capabilities through maintenance services.	Repair / maintenance	Bocken et al. (2016)
		Repair is about restoring a product to a sound/ good condition after decay or damage. After repair, the product is expected to be in a usable state, but assurances of performance are generally limited to the repaired part.	The company is offering products that can be easily repaired.	Repair/ maintenance	Bocken et al. (2016)
	Design for upgradability and adaptability	Upgradability is defined as the ability of a product to continue being useful under changing conditions by improving the quality, value, and effectiveness or performance	The company offers products that can be continuously useful under changing conditions through improving its quality, value effectiveness or performance.	Repair/Maintenance Refurbishment/Remanufacturing Reuse/Redistribute	Bocken et al. (2016)
	Design for standardization and compatibility	Is about creating products with parts or interfaces that fit other products as well	The company offers products with parts or interfaces that also fit with other products.	Repair/Maintenance Refurbishment/Remanufacturing Reuse/Redistribute	Bocken et al. (2016)

	Design for dis- and reassembly	Is about ensuring that products and parts can be separated and reassembled easily. It is a strategy that can be applied to increase the future rates of material and component reuse. This strategy is also vital for separating materials that will enter different cycles (biological or technological).	The company offers products which part's and components can be separated and reassembled easily.	Repair/Maintenance Refurbishment/Remanufacturing Reuse/Redistribute	Bocken et al. (2016)
Closing loops					
Design for a technological cycle	Design for a technological cycle	Suitable for products as a service. Products are designed in a way that materials can be safely and continuously recycled with no quality loss. Does not include thermal recycling (energy recovery)	The company offers products which materials can be safely and continuously recycled and used in new products without a quality loss.	Recycling Cascading	Bocken et al. (2016)
Design for a biological cycle	Design for a biological cycle	Products are designed with safe and healthy materials ("biological nutrients") that create food for natural systems across their life cycle. In a biological cycle, materials are biodegraded to start a new cycle. Biodegradability is the capability of being degraded by biological activity, compositing is a related process, in which organic matter is biologically	The company offers products made of safe and healthy materials that are biodegradable.	Recycling Cascading	Bocken et al. (2016)

		decomposed, performed by microorganisms, mostly bacteria and fungi			
Design for dis- and reassembly	Design for dis- and reassembly	Strategy, which is overlapping with, and contributing to Design for a Technological and Biological cycle. It is about ensuring that products and parts can be separated and reassembled easily. This strategy is also vital for separating materials that will enter different cycles (biological from technological).	The company offers products which parts and components can be separated and reassembled easily.	Recycling Cascading	Bocken et al. (2016)
Narrowing resource flows					
Design for reducing resource consumption	Design for reduction of production steps	The company offers products that need relatively less production steps	The company offers products that need relatively less production steps	Reduce	Moreno et al. (2016)
	Design for light weighting, miniaturizing	The company offers products that are made of light materials and/or are relatively small in their size.	The company offers products that are made of light materials and/or are relatively small in their size.	Reduce	Moreno et al. (2016)
	Design for eliminating yield loses/material/resources/parts/packaging	The company offers products in whose production processes material/resources/parts/packa	The company offers products in whose production processes material/resources/parts/packa	Reduce	Moreno et al. (2016)

		ging/yield losses are being eliminated	ging/yield losses are being eliminated		
	Design for reducing material/resource use	The material consumption in the production of the products offered by the company is reduced	The material consumption in the production of the products offered by the company is reduced	Reduce	Moreno et al. (2016)

Appendix II

Table 9

Conceptualization of CEBM strategies. The table was used as a coding manual for the content analysis

Strategy	Categorization	Explanation	Assessment criteria	Reverse cycle	Source
Slowing loops					
Access and performance model	Access and performance model	Providing the capability or services to satisfy user needs without needing to own physical products	The company is offering product service systems that seek to provide capabilities or functionalities of a product rather than its ownership.	Reuse/Redistribute (sharing) Rethink	Bocken et al. (2016)
Extending product value	Refurbishment & remanufacture business model	Require combinations of the repair and maintenance and the reuse and redistribution capabilities and business model design options. Require the establishment of the necessary reverse logistics to obtain access to used products or components and that they are capable of improving their physical state. Both reverse and forward logistics and the technical expertise	The company is exploiting the residual value of products and is offering its customers an "as-new" product through refurbishing or remanufacturing an old product.	Refurbishment/Remanufacturing	Bocken et al. (2016) Lüdeke-Freund et al. (2018)

		about products and how to refurbish or remanufacture them are needed to establish such business models. Remanufacturing is more profound than refurbishing and leads to products as good as new, or even better than new. Hence, it involves dismantling, cleaning, checking, testing for compliance, and replacing worn-out parts. Often whole components are reused, leading to material and cost savings. The overall value creation potential of refurbishment and remanufacturing is based on access to goods and components that can be resold, enhanced reputation as a manufacturer, products with as-new quality (including			

		warranty), a reduction of waste handling costs, and less social externalities.			
	Reuse & Redistributing business model	These business models are about offering access to used products, evaluating their market value, which might include slight enhancements or modifications, and creating a market place. On the one hand, manufacturers can offer reuse and redistribution services. On the other	The company is providing a access to used products that allows customers to exploit their residual value (e.g. eBay).	Reuse/Redistribute	Bocken et al. (2016) Lüdeke-Freund et al. (2018)

		hand, these activities (e.g., evaluating, enhancing, and shipping products) can also be done on a pure C2C basis as in the original eBay approach.			
Classic long life model	Longevity business model	Value creation and delivery focuses on durable product design	The company is offering long-lasting and high-quality products.	Refuse	Bocken et al. (2016)
	Repair & Maintainace business model	Business models focused on delivering long-product life, supported by design for durability and repair for instance. Require companies to have customer-centric services, corresponding forward and reverse logistics, up-to-date product expertise, and fast learning and problem-solving capabilities. Can range from offering warranties or additional services by the OEM or external services through service providers	The company is offering high levels of product service to maintain/prolong the original product purpose	Repair/Maintenance Reuse/Redistribute	Bocken et al. (2016) Lüdeke-Freund et al. (2018)

Encourage sufficiency	Sufficiency business model	Similar to the "classic long life model", "encourage sufficiency" is about long- lasting products. **However, for sufficiency business models a "non-consumerist approach to sales" is emphasized.** It includes solutions that actively seek to reduce end-user consumption, in particular through a non-consumerist approach to promotion and sales. The main principle is to make products that last and allow users to hold on to them as long as possible through high levels of service.	The company is actively stating that it is seeking to reduce end-user consumption through principles such as durability, upgradability, service, warrantees and reparability and a non-consumerist approach to marketing and sales (e.g. no sales commissions)	Repair/Maintenance Refurbishment/Remanufacturing Reuse/Redistribute	Bocken et al. (2016)

Closing loops					
Extending resource value	Recycling Business Models	Recycling can take 3 different forms: **Primary recycling:** Mechanical reprocessing into a product with equivalent properties. "Upcycling" is concerned with retaining or improving the properties of the material. **Secondary recycling**: Mechanical reprocessing into products requiring lower properties. In secondary recycling, material is reprocessed into a "low" value product, such as industrial grade rubber being reprocessed into a general grade rubber. **Tertiary recycling**: Recovery of the chemical constituents of a material. More extensively defined as the structural breakdown of materials into their original raw	The company is conducting the recycling of materials in the form of up- or down-cycling.	Recycling	Bocken et al. (2016) Lüdeke-Freund et al. (2018)

		core components (for instance depolymerization) and consecutive buildup (repolymerization).			
Biological business models	Cascading business models	Value creation processes based on cascading rely on taking and winning back the biological nutrients contained in product components, used materials, and waste	The company is creating value through taking and winning back the biological nutrients in product components, used materials and waste	Recycling Cascading	Lüdeke-Freund et al. (2018)
	Organic Feedstock BM	**Biomass** conversion provides inputs for production processes, thereby closing the loop. **Composting** produces soil-like residues that can be used as soil amendments and	The company is creating value through processing organic residuals via biomass conversion, composting or anaerobic digestion.	Recycling Cascading	Lüdeke-Freund et al. (2018)

		disposed of into the biosphere. **Anaerobic** digestion is mainly used to produce biogas and solid components that can serve as fertilizer			
	Energy recovery business models	The recovery of energy from materials	The company is creating value through the conversion of waste materials into useable heat, electricity or fuel.	Recover	Lewandowski (2016)
Industrial symbiosis	Industrial symbiosis BM	Industrial symbiosis is a process-orientated solution, concerned with turning waste outputs from one process into feedstock for another process or product line. Whereas industrial symbiosis practices often take place at the process and manufacturing level and benefit from businesses located closely within a geographical area, "extending resource value" often happens at the product level and	The company is creating value from waste from a industrial process that is used as a feedstock in another process or product-line.	Recycling Cascading	Bocken et al. (2016)

		may happen across geographical areas			

Appendix III

Table 10

Interview guide

Topic	Questions
CE related questions	When we talk about a circular economy – what does this concept entail for you? Which practices of a circular economy do you prefer in your investment decisions? Why do you prefer them?
Perception on own role in the transition	How would you describe your role in the transition towards a more circular/sustainable economy? What do you think would need to change to accelerate investments in circular/sustainable BM? (Landscape (for example policy) or the financial system itself (like a shift away from only focusing on profit maximization) In which way has the financial sector to change to forester the transition?
Reasons to invest circular/sustainable start-ups	What are the benefits for your organization from integrating circularity into your investment strategy? What goal do you follow with your investments? More financial/profit maximization or intrinsic motivation to change the economy/society towards more sustainability?
Barriers	What are the main barriers you are facing when it comes to investing in sustainable start-ups? Are there any barriers that can be linked particularly to the CE?
Risks	What kind of risks do you consider in your investment decisions? Would you say your investments are more risky than conventional investments due to your focus on sustainability/circularity?

Appendix IV

Fundholder	Fund name	Investment focus	Source
Black Rock	BGF Circular Economy	The Circular Economy Fund seeks to maximize total return. The Fund invests at least 80% of its total assets in the equity securities of companies globally that benefit from, or contribute to, the advancement of the "Circular Economy".	https://www.blackrock.com/ch/individual/en/products/310165/blackrock-circular-economy-fund
BNP	BNP Paribas Easy ECPI Circular Economy Leaders	The Index is composed of companies related to the opportunities offered by the Circular Economy with positive Environmental, Social and Corporate Governance (ESG) ratings (such as circular supplies, product life extension, recycling, human capital, corporate governance, etc.) and based on their efforts to reduce their exposure to coal and unconventional fossil fuels	https://www.bnpparibas-am.com/de-de/professionelle-investoren/fundsheet/aktien/bnp-paribas-easy-ecpi-circular-economy-leaders-track-classic-c-lu1953136790/?tab=overview
Candriam	Candriam Sustainable Equity Circular Economy	[The fund invests in] companies throughout the world which are considered to become the future leaders of the Circular Economy. Companies involved in activities which contribute to recycling, replacement, repurpose and rationalization of products and resources. The sub-fund aims to invest in 'circular enablers', that have their core business positively aligned with the Circular Economy principles & 'circular transformers', that contribute to facilitate the mutation of the current economy into a circular one.	https://www.candriam.com/en-it/professional/funds-lister/fund-detail/LU2109440870/
Decalia	Decalia Circular Economy A1	DECALIA Circular Economy is a global equity fund focused on companies that will structurally benefit	https://www.decalia.com/en-it/class/decalia-circular-economy-a1-eur/

		from, or enable, the Circular Economy transition. The strategy invests through 2 main cycles: 1) The technical cycle, products and materials are kept in circulation through processes such as reuse, repair, re-manufacture and recycling. 2) The biological cycle, the nutrients from biodegradable materials are returned to the Earth to regenerate nature.	
Robeco	RobecoSAM Circular Economy Equities D	Invests in leading companies that address the opportunities created by the paradigm shift in traditional production and consumption patterns toward a circular economy. Focus on innovative solutions in the area of redesign inputs, circular use, enabling technologies and loop resources. Diversified strategy enhanced by proprietary ESG risk considerations, appealing to investors with a horizon of three to five years.	https://www.robeco.com/en-int/products/funds/isin-lu2092759294/robecosam-circular-economy-equities-d-usd

Appendix V

Table 11

Codebook of the coded interview transcripts concerning RQ2.1 and RQ2.2

Name	Beschreibung	Datei	Referenzen
Barriers		0	0
Barriers related to conventional finance		0	0
Conventional finance does not work as a driver		1	1
Conventional VCs still attractive		1	1
Financial performance outweighs impact		1	2
Lack of demonstration of sustainable technologies as a barrier		1	1
Current assessment matrixes too much focused on financial aspects		1	4
Investors are weighting profit over sustainability		1	1
Duration of investment		1	1
Investor's short time horizon as a barrier		3	4
Investors time horizon too short for a full transition		1	2

Name	Beschreibung	Datei	Referenzen
Missing patience of VC's investors		1	2
Time horizon no barrier		1	1
Time horizon to develop technology		2	2
Impact as an uncertain benefit for capital acquisition on a global level		1	1
Lack of expertise as a hurdle		1	1
CE specific barriers		0	0
Cooperation along the supply chain as a barrier for the CE		1	1
Cultural barrier amongst consumers		1	1
High energy consumption as a barrier for circular investments		1	1
Missing infrastructure as a barrier for circular investments		1	2
No barriers for sustainability investments		1	1
Start-up related barriers		0	0
CE often not sustainable enough for the requirements of the fund		1	2
Greenwashing as a barrier		2	2
Start-up's sustainability performance as a barrier		1	1

Name	Beschreibung	Datei	Referenzen
Different reasons make start-ups not attractive for VCs		1	1
Economic factors		0	0
Assessment reveals that products won’t survive in the market		1	1
start-up is not expected to service on the market		2	2
Start-up is too easy to copy by market competitors		1	1
Start-up unable to compete against current solutions		3	5
Sustainable solution must be able to compete against existing solutions		1	2
Sustainable solutions too expensive to compete against the current products		1	2
Start-up's solution is too complicated for the market		1	1
Lack of circular start-ups that can prove to be profitable in the future as a barrier		1	3
Start-up's are not expected to bring enough financial return		2	2
Start-ups financially not attractive		1	1

Name	Beschreibung	Datei	Referenzen
Start-ups require too much capital and are thus too risky		1	1
Sustainable technologies being too capital intensive		2	2
Structural barriers		0	0
Incumbent resistance as a barrier		2	3
Incumbent's requirements as a barrier for start-up growth		1	2
Lack of market maturity as a barrier		1	1
Regulation as a barrier in the transition		3	6
What needs to change		0	0
Different types of funding are needed to make the investments less risky		1	1
extensive policy needed		1	1
Carbon tax to enable more investments into sustainability		1	1
Fostering sustainable innovations and punishing unsustainable ones		1	1
Policy to enable more investments into sustainability		2	2

Name	Beschreibung	Datei	Referenzen
New policy and market standards required for more investments into sustainability		1	1
Policy and market shift towards more sustainability has already happened		1	1
policy needed to make circular business able to compete		1	1
Longer time horizons to give VCs more flexibility		1	1
More patience capital needed		1	2
More patience needed amongst the VCs		1	2
Market needed to change for more sustainability investments		1	2
More customer awareness for more sustainable investments		1	1
More handwear-focused start-ups needed		1	2
More profitable exits for more sustainable investments		2	2
Sustainable investments raise incumbents interest in the topic		1	1
Need for uniform assessment criteria regarding sustainability		2	3

Name	Beschreibung	Datei	Referenzen
EU regulation not mature enough		1	1
Market has to change towards uniform sustainability assessment		1	1
Sustainability needs to be integrated into assessment criteria		1	2
The need for system thinking		1	1
Benefits of investing in the CE		0	0
Contributing to EU sustainability goals		1	1
Growth potential as a benefit for sustainable investments		1	2
Impact as a benefit for employer recruiting		1	1
Integrating sustainability in an early stage is beneficial		1	1
Sustainability focus beneficial for raising money		6	7
Impact as a benefit to attract capital		1	2
Sustainability as an asset class for pension funds		1	1
Disrupting existing systems		1	1
Disruption not always realized		1	1

Name	Beschreibung	Datei	Referenzen
Having an impact on incumbents' practices		1	1
Drivers		0	0
policy as a driver		3	5
Finance gap as the reason to invest in the bioeconomy		1	1
SDGs as drivers for sustainable investments		1	1
Uncertain impact of regulation		1	1
societal movements as drivers		1	1
Sustainability as a business opportunity		2	4
awareness for sustainability has grown		1	1
Incumbents seeking for novel technologies		1	3
Incumbents as change makers		1	2
Incumbents as drivers for investments		2	2
Industries are shifting towards sustainability		1	1
market opportunity as a driver for change		1	1
Implementing sustainability creates value		1	1

Name	Beschreibung	Datei	Referenzen
Market shift towards sustainability		1	1
VC responding to demand on the market		1	2
Reasons to invest in the CE		0	0
Focus within the CE		0	0
CE activities with highest environmental and social impact most attractive		1	1
Circular consumer facing solutions particular interesting		1	1
Circular materials particular interesting		1	1
Focus on circular bioeconomy		2	2
Bio-based technologies in the beginning of the transition		1	1
Focus on bio-based materials due to rarity		1	1
Focus on bio-economy; Circularity as a bonus		1	1
Focus on recycling and biodegradability		1	1
Focus on the usage of biomass		1	2
Policy as the initial door opener to invest in the bioeconomy		1	1

Name	Beschreibung	Datei	Referenzen
Replacing fossil resources with bio-based feedstock		1	2
Focus on clim-tech		1	1
Focus on recycling due to regulation		2	3
Focus on sustainability		1	1
Measuring circularity		1	1
No focus within CE		2	5
Why investing in CE		0	0
CE as an interesting investment		2	2
Circularity as a business opportunity		2	2
Circular investments are more future proved		1	2
Circularity provides a variety of investments opportunities		1	1
Investments in CE to achieve overreaching goals		2	3
CE contributing to climate focus		4	6
CE with a moderate impact on climate goals		1	1
CE contributing to sustainability aspects		5	7
Environmental benefit		1	1
No CE focus		3	5

Name	Beschreibung	Datei	Referenzen
Only a small focus on CE		1	1
The considered risks		0	0
Assessment criteria		0	0
Balance between sustainability and profitability		2	2
Environmental and social value added to financial return as main requirement		1	1
policy needed to develop new assessment criteria		1	1
Considering sustainability impacts in the company assessment		2	5
Consideration of environmental and social risks		1	1
Extensive impact risk assessment		1	1
Risk adjusted returns as assessment criteria		1	1
Own investors setting investment requirements		1	1
Risk adjusted assessment		1	1
Impact investment financially not more risky		3	3
Sustainable investment prevents investors from taking certain risks		1	1

Name	Beschreibung	Datei	Referenzen
Sustainable investments are less risky		4	4
Clear demand for sustainable solutions		1	1
Unsustainable investments being more risky		1	1
Shifting finance towards sustainable transition is too risky		1	2
Sustainable investments are riskier		2	2
VC is always risky		1	1
The investment goals of the VCs		0	0
Achieving impact through growth of sustainable start-ups		1	1
Aiming to contribute to a sustainable development		1	1
Aiming to develop climate related technology		1	4
Supporting industries to transition towards less carbon intensity		1	2
Industries with a big impact on climate change		1	1
Aiming to generate capital for own investors		1	2
Aiming for risk-adjusted returns		1	1

Name	Beschreibung	Datei	Referenzen
Customer's of VC's investors asking for sustainable investments		1	1
Different investment goals amongst the VC's investors		1	1
Aiming to generate capital to keep the fund going		1	1
Combining impact and profit		2	5
Financial return combined with ecological and social impact		1	1
Equal consideration of impact and profit		1	1
No explicit aim to forester the transition		1	1
Strengthening social entrepreneurship		1	1
Strengthening the market position		1	1
Sustainability transition as a part of the VC's goal		1	1
VC's mission aligns with personal values		5	7
The VCs’ role in the transition		0	0
Developing sustainability in a market environment		1	1
Making impact financially attractive		1	1

Name	Beschreibung	Datei	Referenzen
Start-ups providing new technology for incumbents to change		1	1
Supporting start-ups to establish on big markets		1	1
Developing technology to make it market proof		1	1
Disruption has already happened		1	1
Accelerating the transition		1	1
enabling growth		2	2
Enabling growth by providing money		3	3
Enabling growth by providing stewardship		1	1
supporting start-ups to integrate sustainability		1	1
providing capital for the right companies		1	2
Providing financial support through the valley of death		1	1
Steering capital towards impact		1	1
Supporting companies to grow		2	2
Finance in the role of an intermediary of capital		1	3
Finance is needed for the transition		1	2

Name	Beschreibung	Datei	Referenzen
Role of an accelerator in the transition		1	1
Potential of disruption not required		1	1
Proving that profit and impact can be combined		3	6

Appendix VI

Table 12

Example of coding schedule for CEBMs of the company ‘caterpillar’

Business model strategies						
Slowing loops						
Access and performance model		The company is offering product service systems that seek to provide capabilities or functionalities of a product rather than its ownership.	x	Selected products	The company creates value through renting out its products instead of selling them.	https://www.cat.com/en_US/products/rental.html
Extending product value		The company is exploiting the residual value of products and is offering its customers an "as-new" product through reparing of remanufacturing an old product.	x	Selected products	The company creates value through taking back old products, refurbishing them and selling them again as "as-new" products	https://www.caterpillar.com/en/company/sustainability/remanufacturing.html
		The company is providing a access to used products that allows customers to exploit their residual value (e.g. eBay).				
Classic long life model		The company is offering long-lasting and high-quality products.				
		The company is offering high levels of product service to maintain/prolong the orginal product purpose	x	Selected products	The company is creating value through a reparing program of its products	https://www.caterpillar.com/en/company/sustainability/remanufacturing.html
Encourage sufficiency		The company is actively stating that it is seeking to reduce end-user consumption through principles such as durability, upgradability, service, warrantees and reparability and a non-consumerist approach to marketing and sales (e.g. no sales commissions)				
Closing loops						
Extending resource value		The company is conducting the recycling of materials in the form of up- or down-cycling.				
		The company is creating value through taking and winning back the biological nutrients in product components, used materials and waste				
		The company is creating value through processing organic residuals via biomass conversion, composting or anaerobig diegestion.				
		The company is creating value through the conversion of waste materials into useable heat, electricty or fuel.				
Industriual symbiosis		The company is creating value from wate from a industrial process that is used as a feedstock in another process or product-line.				