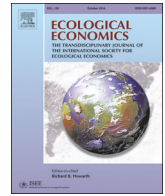




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## Analysis

## Barriers to the Circular Economy: Evidence From the European Union (EU)

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## ABSTRACT

The circular economy concept is much discussed in the European Union (EU), but only limited progress has been accomplished so far regarding its implementation. Most scholarly studies blame this on various technological barriers. Our work rebuts these studies. We present the first large-N-study on circular economy barriers in the EU (208 survey respondents, 47 expert interviews). We find that cultural barriers, particularly a lack of consumer interest and awareness as well as a hesitant company culture, are considered the main circular economy barriers by businesses and policy-makers. These are driven by market barriers which, in turn, are induced by a lack of synergistic governmental interventions to accelerate the transition towards a circular economy. Meanwhile, not a single technological barrier is ranked among the most pressing circular economy barriers, according to our research. Overall, our work suggests that circular economy is a niche discussion among sustainable development professionals at this stage. Significant efforts need to be undertaken for the concept to maintain its momentum.

## 1. Introduction

The circular economy (CE) is a contested concept (Skene, 2017; Korhonen et al., 2018). A recent meta-definition which is based on an analysis of 114 definitions of the term reads: “A [CE] describes an economic system that is based on business models which replace the ‘end-of-life’ concept with reducing, alternatively reusing, [and] recycling [...] materials in production/distribution and consumption processes, [...] 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, pp.224–225). We adopt this (abridged) CE definition for this paper.

The CE is receiving increasing attention in the popular as well as scholarly discourse as indicated, inter alia, by the exponential growth of both practitioner and scholarly writings on the topic (D’Amato et al., 2017; Murray et al., 2017). However, the core ideas of the CE concept have already emerged in the 1960s (e.g. Boulding, 1966) and have been further discussed throughout the 1970s and beyond (e.g. Stahel, 1981) (Blomsma and Brennan, 2017). Much of the current enthusiasm regarding the CE seems to be fueled by its alleged benefits for sustainable development (Homrich et al., 2017; Bocken et al., 2016). For instance, the CE could reduce CO<sub>2</sub> emissions by 48%, create a net economic benefit of EUR 1.8 trillion, and two million additional jobs until 2030 in

the European Union (EU) (Ellen MacArthur Foundation, 2015; European Commission, 2014a).

While many in business and policy circles have proclaimed their support for the CE (European Commission, 2008; Lacy and Rutqvist, 2016), its implementation still appears to be in the early stages (Ghisellini et al., 2016; Stahel, 2016). China may be the only notable exception. The country adopted its ‘Circular Economy Promotion Law of the People’s Republic of China’ in 2009 and has been at the forefront of CE implementation ever since (Geissdoerfer et al., 2017; Geng et al., 2013; Lieder and Rashid, 2016; Liu and Bai, 2014), although it is arguably still far away from achieving what Dijkema & Kamp (2016, p.23) call “full circularity”. Some also see The Netherlands as a frontrunner regarding the CE (van Buren et al., 2016; Bastein et al., 2013).

Scholars have attributed the limited progress in CE implementation to a variety of CE barriers with a specific literature having developed around CE barriers in recent years (e.g. Pheifer, 2017; Shahbazi et al., 2016; Rizos et al., 2015; Preston, 2012; de Jesus and Mendonça, 2018; Vanner et al., 2014; Ranta et al., 2017; van Eijk, 2015; Mont et al., 2017; further discussed in Section 3). The most notable recent contribution to this literature may be de Jesus and Mendonça (2018), published in this very journal. de Jesus and Mendonça (2018) aggregate previous findings regarding CE barriers with the intention to develop a CE barriers framework. The authors close their study by noting that their “CE [barriers] framework requires more empirical content” (de

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Jesus and Mendonça, 2018, p.85). This is the point of departure for our work.

The research question answered in this study is: What are the main barriers that derail or slow down the transition towards a CE in the EU? We chose the EU as our regional focus since the European Commission (EC) has adopted a variety of ambitious CE policies, e.g. its ‘Circular Economy Package’ (launched in 2015 and later updated in 2018) with a focus on closing the loop of product lifecycles through greater re-use and recycling (European Commission, 2015, 2018; Lazarevic and Valve, 2017). Despite the adoption of these policy measures, most EU Member States are said to have seen limited CE implementation so far (McDowall et al., 2017; Stahel, 2014). Therefore, to answer our research question and provide insights for future CE policy development, we present the first large-N-study on CE barriers to date, as far as we are aware. For this, we conducted 47 interviews with CE experts, supplemented by a survey with 208 stakeholders from businesses and governments in the EU.

While the previous literature on this topic particularly emphasized technical barriers as key barriers for CE implementation, various cultural barriers appear as main barriers in our work. The two core cultural barriers identified are ‘lacking consumer interest and awareness’ as well as ‘hesitant company culture’. This finding suggests that the CE may still be a niche discussion among sustainable development professionals, despite the increasing attention received by the concept in recent years. Furthermore, our work suggests that an intervention strategy is needed that does not focus on research and development (R&D) for CE any longer. Overall, this study may serve as a warning for those who think that the current high interest in the CE may automatically translate into CE implementation successes.

The remainder of this paper is organized as follows. We discuss our material and methods in the next section. We then outline our theoretical framing. Results are presented and discussed in Section 4, while our argument is summarized in Section 5.

**2. Material and Methods**

Data collection for this paper has been undertaken throughout 2017. This entailed three components: desk research, semi-structured interviews and a survey. Interviewees and survey respondents were from all over the EU, e.g. Belgium, Germany, the Netherlands, Portugal, Sweden and the United Kingdom.

*Desk research* started by undertaking searches in Elsevier’s Scopus, Thomson Reuters’ Web of Science and Google with the keywords ‘circular economy’ and ‘barriers’ (as well as ‘circular economy’ in combination with several synonyms of barriers, e.g. ‘obstacles’ or ‘hindrances’). We included Google as a search engine since the scholarly literature on the CE has been significantly shaped by practitioner writings, with the latter thus constituting a core component of the CE literature (Blomsma and Brennan, 2017; Schut et al., 2015). We examined bibliographies of identified relevant studies, e.g. de Jesus and Mendonça (2018), Shahbazi et al. (2016) Rizos et al. (2015), to identify further relevant literature. Overall, more than 30 studies on CE barriers were identified. These were reviewed by the authors of this paper to develop a foundational understanding regarding CE barriers. Based on this, an initial coding framework regarding CE barriers was developed, which aided the first round of analyses of the semi-structured interviews carried out.

*Semi-structured interviews* were conducted for this work with experts on the CE (Table 1). We talked to businesses, policy-makers and academics since the CE has been argued to be a “multi-actor [concept]” (de Jesus and Mendonça, 2018, p.85) with these groups widely seen as those at the forefront of the transition towards a CE (Lieder and Rashid, 2016; Bocken et al., 2016). We built a judgement sample for this work, which is a non-random sample of respondents selected by the researchers based on to their knowledge on the topic under investigation (Marshall, 1996; Kirchherr, 2018). First, we created a list of 195 CE

**Table 1**  
Overview of interviews.

#	Position	Organization	Type
1	Chief Executive Officer (CEO)	Circular start-up	Business
2	Managing Director	Circular start-up	Business
3	Chief Executive Officer (CEO)	Circular start-up	Business
4	Co-founder	Circular start-up	Business
5	Manager (Sales)	Circular start-up	Business
6	Managing Director	SME	Business
7	Manager (Environmental Affairs)	SME	Business
8	Managing Director	SME	Business
9	Manager	Incumbent	Business
10	Sustainability Director	Incumbent	Business
11	Manager (Business Intelligence and Innovation)	Incumbent	Business
12	Manager (Sustainability)	Incumbent	Business
13	Advisor (Business Development)	Incumbent	Business
14	Head of Health, Safety, Security & Environment	Incumbent	Business
15	Advisor (Sustainability)	Incumbent	Business
16	Managing Director	Incumbent	Business
17	Manager	Incumbent	Business
18	Scholar	University	Academia
19	Scholar	Research institute	Academia
20	Scholar	University	Academia
21	Scholar	University	Academia
22	Founder	Research institute	Academia
23	Scholar	Research institute	Academia
24	Scholar	Research institute	Academia
25	Scholar	Research institute	Academia
26	Scholar	University	Academia
27	Scholar	University	Academia
28	Scholar	University	Academia
29	Scholar	University	Academia
30	Scholar	University	Academia
31	Director	Research institute	Academia
32	Director	Research institute	Academia
33	Policy-maker	County government	Government
34	Policy-maker	County government	Government
35	Program Manager (Circular Economy)	County government	Government
36	Advisor (Circular Economy)	County government	Government
37	Policy-maker	Country government	Government
38	Program Leader	Country government	Government
39	Program Manager	Country government	Government
40	Advisor (Sustainability)	Country government	Government
41	Project Manager	Government council	Government
42	Policy-maker	European Commission	Government
43	Advisor (Circular Procurement)	National government	Government
44	Advisor (Innovation)	National government	Government
45	Policy-maker	National government	Government
46	Program Manager	City government	Government
47	Project Leader	National government	Government

experts in the EU and reached out to all of them, which resulted in 40 interviews (success rate: 20.5%). Second, we complemented this list by snowball sampling (Handcock and Gile, 2011) to also leverage the insights of our interviewees about CE experts. For this, we asked each interviewee to indicate suitable additional interviewees. This produced 11 novel referrals, which, in turn, resulted in 7 more interviews (success rate: 63.6%). Before conducting the interviews, an interview guide was designed with questions aimed at probing the familiarity of each interviewee with the CE concept, perceived barriers to CE implementation and possible ways to overcome them. Interviews lasted between 45 and 60 min on average and were carried out face-to-face as well as via telephone and Skype. Anonymity was ensured since we believe that this approach helped us gain more trust and, thus, obtain additional insights regarding CE barriers (Berry, 2002; Kirchherr et al., 2017). We provide selected details regarding interviewees whenever possible. All interviews were coded by two authors of this paper based on the mentioned initial coding framework. This framework was further refined using the results of the semi-structured interviews. The eventual coding framework is depicted in Table 2 and further described in Section 3.

**Table 2**  
Coding framework of CE barriers.

Barrier		Example source
Cultural Lacking awareness and/or willingness to engage with CE	Hesitant company culture	“No sense of urgency, company culture” Pheifer (2017, p.12)
	Limited willingness to collaborate in the value chain	“Difficult to collaborate with other companies” Mont et al. (2017, p.29)
	Lacking consumer awareness and interest	“Lack of consumer awareness” Mont et al. (2017, p.30)
	Operating in a linear system	“Current linear system in place” Pheifer (2017, p.15)
Regulatory Lacking policies in support of a CE transition	Limited circular procurement	“We need people who do not only look at costs when doing procurement, but also at other things” Manager (incumbent)
	Obstructing laws and regulations	“Current governmental legislations and ruling” Pheifer (2017, p.15)
	Lacking global consensus	“There are a lot of different countries, so you need a high level of consensus and that is not easy” Director (research institute)
Market Lacking economic viability of circular business models	Low virgin material prices	“Low prices of many virgin materials” Mont et al. (2017, p.28)
	Lacking standardization	“There is a lack of standards” Scholar (university)
	High upfront investment costs	“High upfront investment costs” Mont et al. (2017, p.29)
	Limited funding for circular business models	“Financing of circular business propositions” Pheifer (2017, p.11)
Technological Lacking (proven) technologies to implement CE	Lacking ability to deliver high quality remanufactured products	“Limited availability and quality of recycled materials” IMSA (2013, p.4)
	Limited circular designs	“Products are not designed for circular business models” Mont et al. (2017, p.30)
	Too few large-scale demonstration projects	“Limited application of new business models” IMSA (2013, p.4)
	Lack of data, e.g. on impacts	“Lack of data” Pheifer (2017, p.14)

In the *survey* respondents were asked to indicate the 5 most pressing CE barriers out of the 15 we identified and included in the coding framework (Table 2). Our survey was filled out by 153 businesses and 55 government officials in the EU. We reached out to 390 businesses for our survey (success rate: 39.2%) as well as 155 government officials (success rate: 35.4%). We focused our survey on the perspectives of businesses and policy-makers since these are believed to be the key actors for implementing CE (European Commission, 2014b; Bocken et al., 2017). Moreover, the responses provided by businesses and policy-makers offer a unique account of the barriers to the CE experienced from a practitioner perspective. We used the list of CE players provided by *Circulair ondernemen* (Circulair Ondernemen, 2017) as well as an internal Deloitte database as our sampling frame (Morgan, 2008). A core intention of our survey was to reveal findings with a greater external validity than those found in previous research. The largest study on CE barriers from a sample size perspective that we identified is Shahbazi et al. (2016), which is based on 41 semi-structured interviews. This is followed by Rizos et al. (2015), with a study based on 30 semi-structured interviews. Other literature that we examined relies on 18 interviews (Ritzén and Sandström, 2017), eleven interviews (IMSA, 2013) or even only nine interviews (Pheifer, 2017). Our study thus appears to be the first large-N-study on barriers to the CE, as already claimed in Section 1 of this paper.

In the next section we describe in more detail the theoretical framing of this work and the categories of CE barriers that emerged from our desk research and the semi-structured interviews.

### 3. Theoretical Framing

Kirchherr et al. (2017, p.229) write that “CE must be understood as a fundamental systemic [innovation] instead of a bit of twisting the status quo”. Indeed, the CE requires essential changes in current production and consumption patterns. For instance, imagine a shift from a

throw-away beverage can system, a typical example of the linear economy, to a bottle deposit return scheme, an example of CE (Campbell et al., 2016). First, novel technologies will be needed for this latter system, e.g. inspection and cleaning technology for returned bottles (den Hollander et al., 2017). Second, the players in the market will need to change a variety of their activities for this novel system and thus their interplay, e.g. reverse logistics is now required for the returned bottles (Frei et al., 2016). Third, novel policies must be adopted to regulate the novel technology, e.g. policies regarding chemical usage for cleaning these bottles (Milios, 2017). Fourth, cultural shifts are needed, e.g. the consumers now must learn to return bottles instead of throwing them away (Repo and Anttonen, 2017).

de Jesus and Mendonça (2018) distinguish between soft and hard barriers that impede the implementation of CE as a systemic innovation. This distinction is inspired by Nye (1990, 2006) who distinguished between soft and hard power. Soft power is associated with the ability to bring about change by attracting others through values and institutional practices that shape their attitudes and preferences, while hard power refers to the ability to force change through technical or economic means. We chose not to adopt a distinction between soft barriers and hard barriers in our study since we fear that it may confuse some readers, particularly those with a background in sociology or political science with these two disciplines recently taking an increasing interest in the CE (Milios, 2017; Geissdoerfer et al., 2017). For instance, institutional theory – which is prominent both in sociology and political science and which is also employed in the discourse on CE barriers, e.g. by Ranta et al. (2017) – would frame legislation as a hard barrier (Amenta and Ramsey, 2010; Ansell and Torfing, 2016), whereas de Jesus and Mendonça (2018), based on Nye (1990, 2006), would frame it as a soft one.

While we do not adopt the distinction in soft and hard barriers proposed by de Jesus and Mendonça (2018), we adopt their conceptualization regarding the four main categories of barriers.

Throughout this paper, we distinguish between ‘cultural’, ‘regulatory’, ‘market’ and ‘technological’ barriers. We further explain these four types of barriers and their 15 sub-barriers in Table 2. We note that some of the literature examined has identified more than 15 barriers. For instance, van Eijk (2015) lists 21 barriers. However, in building our framework we aimed to balance comprehensiveness and parsimony (Cramer, 2013; Dholakia and Turcan, 2014). Hence, we chose to group together several barriers that were listed as separate by other scholars. For example, we combined “circularity is not effectively integrated in innovation policies” (van Eijk, 2015, p.33) and “governmental incentives support the linear economy” (van Eijk, 2015, p.33) into ‘obstructing laws and regulations’ in our framework.

We conclude this section by two remarks regarding our framework presented in Table 2. First, we observe that the four categories of barriers presented can be considered as nested (Fig. 1). For instance, it can be argued that cultural barriers determine regulatory barriers since regulation can follow culture (Hancher and Moran, 1989); regulatory barriers, in turn, can determine market barriers with regulation frequently creating markets (Marshall, 2012). Market barriers then can determine technological barriers since certain market forces, e.g. funding for a certain technology, are needed for technologies to emerge (Ahn, 2016). We explain the possible nesting of the various sub-barriers in the supplementary materials (Table A1).

Second, we note that there are multiple possible interaction effects between the various categories of barriers as also pointed out, among others, by de Jesus and Mendonça (2018). For instance, if there is a ‘Lack of data, e.g. of impacts’, market actors (e.g. companies) may have limited interest in implementing CE business models, thus encouraging the persistence of ‘Limited funding for circular business models’ and low pressure to remove ‘Obstructing laws and regulations’. This, in turn, may make CE products and services more expensive, which may further result in ‘Lacking consumer awareness and interest’ (Fig. 1).

Interactions among the four interrelated categories of CE barriers can result in a chain reaction towards CE failure, thereby leaving unchanged the current linear economic system. However, a detailed analysis of the four categories of CE barriers and their different sub-categories can provide insights into the main causes of an unsuccessful transition to a CE. Once the latter are identified, it is possible to design

targeted interventions aimed at breaking the chain reaction leading to CE failure and replace it with one that is geared towards a successful CE transition. We discuss the relevance and possible chain reaction of the various CE barriers included in our framework in the next section.

#### 4. Results & Discussion

We present the findings on CE barriers in sequence of their relevance, as identified in our survey (Table 3). Hence, we start with cultural barriers, before moving on to markets barriers, regulatory barriers and, finally, technological barriers. We usually describe results from the angle of the full sample. However, we also discuss findings from a specific stakeholder angle whenever marked differences between our stakeholder groups were identified (with our stakeholder groups being ‘businesses’ and ‘policy-makers’). We further support and elaborate on the survey results using quotes from the semi-structured interviews.

We initially assumed that barriers may also depend on the varying understandings of respondents regarding the CE concept; after all, CE means many different things to different people (Kirchherr et al., 2017; de Jesus et al., 2018). However, we found that this was not the case. As such, we do not further discuss varying understandings of the CE concept in this section.

##### 4.1. Cultural Barriers

Cultural barriers, particularly barriers regarding consumers and company culture, are discussed in various contributions on CE barriers, e.g. van Eijk (2015), Mont et al. (2017), Vanner et al. (2014), Ranta et al. (2017) and Pheifer (2017). For instance, Vanner et al. (2014, p.5) writes that “limited consumer [...] acceptance” would be one explanation regarding CE’s limited implementation progress so far. This is in line with Ranta et al. (2017, p.5), who argue that “customers prefer new products”. In relation to company culture, Pheifer (2017, p.10) finds that CE “[is] not integrated in the strategy, mission, vision, goals & key performance indicators”, which suggests that companies have not mainstreamed the concept yet. Nevertheless, de Jesus and Mendonça (2018) report that cultural barriers are the least mentioned category of

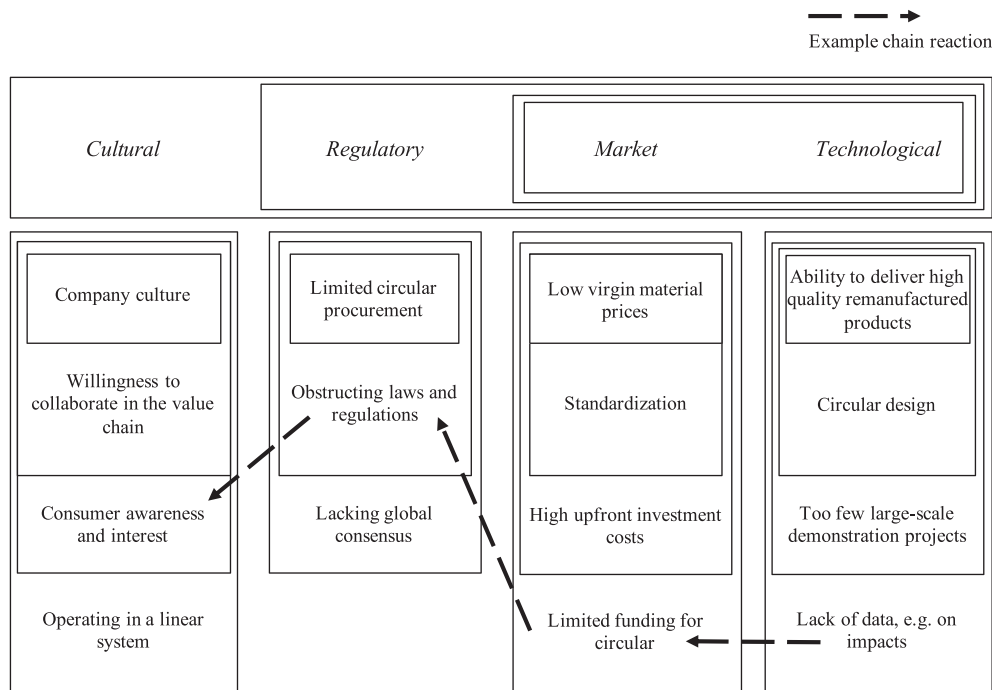


Fig. 1. Theorizing CE barriers.

**Table 3**  
Barriers to the CE – survey results.

Mentioning of barrier: percentage and rank (in brackets)		Full sample n = 208	Stakeholder perspective	
			Businesses n = 153	Policy-makers n = 55
Cultural	Lacking consumer interest and awareness	47% (1)	44% (2)	53% (2)
	Hesitant company culture	46% (2)	48% (1)	40% (7)
	Operating in a linear system	44% (4)	42% (3)	47% (4)
	Limited willingness to collaborate in the value chain	38% (6)	36% (6)	42% (5)
Market	Low virgin material prices	45% (3)	39% (4)	62% (1)
	High upfront investment costs	40% (5)	37% (5)	49% (3)
	Limited funding for circular business models	24% (10)	25% (11)	18% (10)
	Limited standardization	13% (14)	14% (14)	11% (15)
Regulatory	Obstructing laws and regulations	37% (7)	35% (7)	42% (5)
	Lack of global consensus	25% (9)	29% (8)	15% (14)
	Limited circular procurement	24% (10)	25% (11)	24% (9)
Technological	Limited circular design	29% (8)	28% (9)	33% (8)
	Too few large-scale demonstration projects	24% (10)	27% (10)	16% (11)
	Lack of data, e.g. on impacts	21% (13)	23% (13)	16% (11)
	Ability to deliver high quality remanufactured products	11% (15)	8% (15)	16% (11)

barriers in the relevant literature on CE barriers with only 20% of studies examined raising this category.

This finding is rebutted by our research with three of the five most pressing barriers identified being cultural ones, namely ‘Lacking consumer interest and awareness’, ‘Hesitant company culture’ and ‘Operating in a linear system’. Notably, this result reveals a difference between the key CE barriers indicated in academic literature and those experienced by business and policy practitioners (i.e. our survey respondents). ‘Lacking consumer interest and awareness’ appears as the most mentioned barrier in our study. For example, one of our interviewees claimed that “consumers change their mind too quickly”. This could undermine a firm’s business model resting upon the production of especially durable products – “products which last much longer than the fashion trend”. This barrier resonates with the literature that examines consumers’ interest in sustainability, e.g. Hawkins et al. (2012), Borra et al. (2014) and Kumar and Polonsky (2017), while our finding may be worrying for those keen for a transition towards a CE since consumer interests and awareness are difficult to change. For instance, consumers repeatedly buy the same 150 items that then fulfil 85% of their needs (Schneider and Hall, 2011).

‘Hesitant company culture’ appears as the second most pressing barrier. This finding is at odds with the claims that that CE is widely embraced by companies these days, outlined in Section 1. Rather, it suggests that discussions about the CE may often be restricted to the corporate social responsibility (CSR) and/or environmental departments of a company and have much less appeal in more influential departments such as operations or finance. CE thus appears to be a niche discussion among sustainable development professionals in many companies, according to this work. Moreover, we note that the barrier ‘Lacking consumer interest and awareness’ may result in the barrier ‘Hesitant company culture’, as also implied by some of our interviewees, since companies are conditioned to respond to the consumer (Christensen, 1997; Friedman, 1970).

There is a marked difference regarding the relevance of the barrier ‘Hesitant company culture’ among businesses and policy-makers with this barrier ranking first for businesses, but only seventh for policy-makers. This may indicate that our survey respondents in firms identify obstacles within their own organization, whereas many policy-makers assume that there are many companies that have embraced the CE concept. The view expressed by policy-makers might be due to discussions about the CE being held mainly with firms that are already committed to the CE concept and individuals working in their CSR and/or environmental departments. A discussion with those heading other departments in firms may change the views of policy-makers regarding the current “CE readiness” of companies (Singh et al., 2017, p.427).

‘Operating within a linear business model’ appears as our fourth

most pressing barrier. As put by one of our interviewees: “Our supply chain is very conservative. If you talk about CE, these players only glance at you with a question mark in their eyes”. Again, this finding highlights that the CE has apparently not yet reached the mainstream. Even if a company has chosen to embrace the CE approach, this does not necessarily mean that its supply chain is also willing to embrace it. Yet, in order to reach full circularity a company requires its supply chain to commit to the CE (Witjes and Lozano, 2016; Dijkma and Kamp, 2016).

#### 4.2. Market Barriers

The literature frequently highlights that market barriers hamper the transition towards a CE with both low virgin material prices and costs of CE business models raised as barriers by authors writing on this topic, e.g. Preston (2012), Rizos et al. (2015), Shahbazi et al. (2016), Mont et al. (2017), Pheifer (2017) and Ranta et al. (2017). For instance, Mont et al., (2017, p. 28) suggests that the “low prices of many virgin materials” would prevent CE products to outcompete their linear equivalents. Similarly, Preston (2012, p.10) argues that “the recycling of many materials does not occur because it is uneconomical relative to the production of virgin material”. Furthermore, Ranta et al. (2017) contend that CE initiatives would frequently be so expensive that they would require financial subsidies to ensure their economic viability. This is consistent with findings from Rizos et al. (2015, p.1), who write that “access to suitable sources of finance is key” for firms aiming to transition to a CE. Meanwhile, de Jesus and Mendonça (2018) find that market barriers are the second least mentioned category of barriers in the CE literature with 22% of studies mentioning it.

However, market barriers are the second most pressing category of barriers according to our work, with two of the five most pressing barriers identified being market ones, namely ‘Low virgin material prices’ and ‘High upfront investment costs’. ‘Low virgin material prices’ appears as the third most pressing barrier (and as the most pressing barrier for policy-makers). For instance, one interviewee shared with us that “fossil-fuel based plastics are much less expensive than our bio-based plastics”, which would thus undermine the affordability of the interviewee’s circular products. It can be argued that ‘Low virgin material prices’ are the root cause of the identified cultural barriers. If virgin material prices were higher, there would be more affordable circular products that could spur consumer interest and awareness since consumers are frequently very cost-conscious when making a purchasing decision (Pheifer, 2017); this would, in turn, spur more company interest in circular products, which then may ultimately diminish the barrier ‘Operating in a linear system’.

‘High upfront investment costs’ appears as the fifth most pressing

barrier in our work. One interviewee claimed that “There is still a need for several [CE business model] learning curves”. The interviewee further stated that “the first one that will invest in learning will probably lose money and only the second mover will earn a fortune. Hence, many people are now waiting for each other”. Funding for what the interviewee called “learning” would be available, though; the barrier ‘Limited funding for circular business models’ only ranks as the tenth most pressing barrier in our survey. The barrier ‘High upfront investment costs’ may thus be a symptom of the barrier ‘Hesitant company culture’. Business leaders with a gut feeling that is doubting towards the CE (this embody the identified barrier ‘Hesitant company culture’) may use the rationally-sounding argument “CE is too expensive” to abort a CE initiative.

#### 4.3. Regulatory Barriers

Numerous regulatory barriers are discussed in the literature on CE barriers, e.g. by Vanner et al. (2014), Rizos et al. (2015), van Eijk (2015), Pheifer (2017) and Ranta et al. (2017). For instance, Preston (2012, p.16) diagnoses a lack of “smart regulation” for a transition towards a CE and Rizos et al. (2015, p.1) a lack of a “supportive policy frameworks”, while Pheifer (2017, p.15) specifically warns that “[regulation] prevents cascading material across international borders”. Overall, regulatory barriers appear as the second most pressing barrier in the relevant literature, according to de Jesus and Mendonça (2018), with these barriers mentioned in 23% of the analyzed writings.

Our work somewhat relativizes this result, with no regulatory barrier appearing among the five most pressing barriers indicated by businesses and policy-makers. The most pressing regulatory barrier among those surveyed is ‘Obstructing laws and regulations’, which ranks only seventh out of the 15 barriers surveyed. The need for changes in current laws and regulations is also perceived as more important by policy-makers, who rank the barrier ‘Obstructing laws and regulations’ in the fifth place, compared to businesses, who place it only in the seventh place. Although regulatory barriers did not appear as core barriers in our work, interviewees still raised numerous relevant examples. For instance, one interviewee noted, echoing Pheifer (2017), that “we want to recycle our bakelite that is waste, and we found a company in Belgium that can do this, but we are not allowed to transport this bakelite across the border”. Another interviewee complained that “in our asphalt we can’t use recycled materials in our top layers because it is regulated (...) that this is not allowed”.

Conceivably, we did not find regulatory barriers among the main CE barriers due to the focus of our study on the EU. After all, the EC has proclaimed the CE to be a policy priority since 2015, as already mentioned in Section 1, and it can thus be expected that the most pressing CE regulatory barriers might have already been removed. Despite the EC commitment to the CE, the two market barriers identified in the previous section can be considered as barriers that are (at least partly) induced by governmental intervention. First, many virgin material prices in the EU (with ‘Low virgin material prices’ appearing as a core market barrier, as outlined in the previous sub-section) are artificially low, as also highlighted by Stahel (2013) and Stahel and Clift (2016), since energy for producing these is frequently provided at subsidized rates. The existence of such subsidies could undermine the diffusion of more circular (e.g. reused or recycled) materials. To avoid this, the EU may even consider the stipulation that “all ‘externalities’ should be incorporated into the [final product] price of resources and energy” (Preston, 2012, p.14) and/or the EU may choose to introduce targeted interventions in favor of circular products to accelerate the transition towards a CE, as also proposed by several of our interviewees. An example of such an intervention has recently been provided by Alliance 90/The Greens, a German environmental party. The party proposed that the value added tax (VAT) for any reparations should be lowered from 19% to 7% in Germany to make reparations more attractive (dpa, 2017).

Second, high upfront investment costs for circular business models (with these also appearing as a core market barrier, as outlined in the previous sub-section) could be lowered by government intervention, e.g. through the provision of financial support. Financial support is already a commonly employed policy instrument in the EU, particularly in the agricultural sector (MEZ, 2016; Hodge et al., 2015). If investing in a circular business model would cost as much as in a linear business models, at least the excuse that “CE is too expensive” could not be used any longer. Admittedly, this may not break the chain reaction towards CE failure, but it would at least provide some additional momentum for those keen on a transition towards a CE.

#### 4.4. Technological Barriers

Having the relevant technology in place is a prerequisite for the CE transition, according to much of the relevant literature, e.g. Preston (2012), Vanner et al. (2014), Shahbazi et al. (2016) and Pheifer (2017). However, this prerequisite is not yet fulfilled, according to relevant writings. For instance, Preston (2012, p.10) argues that “the [CE] opportunities are huge if technical barriers could be overcome”, while Shahbazi et al. (2016, p.440) diagnoses lacking “technical [...] detailed knowledge”. Overall, “technical bottlenecks stand out as the perceived source of the greatest challenges” (de Jesus and Mendonça, 2018, p.81) in existing literature with 35% of relevant studies raising these, far more than for any other category of barriers.

In contrast, technical barriers do not emerge as core barriers in our work. Indeed, none of the four surveyed technical barriers appear among the five most pressing barriers. As one interviewee put it: “We have the technology in place”. The technological barrier ‘Ability to deliver high quality remanufactured products’ even ranks as the least pressing of all barriers examined, according to businesses (it ranks eleventh for policy-makers). Some literature, e.g. Shahbazi et al. (2016) and Pheifer (2017), have particularly emphasized design as a major impediment to the CE transition with Pheifer (2017, p.9) writing, for example, that “eight of the nine respondents referred to some aspects of product design as a key barrier to successful circular economy business model innovation” (Pheifer, 2017, p.9). While ‘Lacking circular design’ appears as the core CE barrier among the technological barriers, it only ranks as the eighth most pressing barrier in our survey. It can thus be argued that it is not a major impediment in the transition towards CE.

The difference found in the relevance of technological barriers between existing literature and the results of our survey could be further explored in future research. However, our finding may be encouraging for those keen on a CE transition. If technological barriers dominated, as suggested by much of the current literature, considerable time would be needed to accomplish a CE transition. After all, technological development is slow (Grubler et al., 2016; Bento and Wilson, 2016). For instance, Agarwal and Bayus (2002) found that 30 product innovations in the United States took 30 years on average to move from invention to commercialization. While culture is deeply ingrained (Hays, 1994; Barth et al., 2007) and thus cultural change also slow, we hypothesize that the pace of cultural change may outpace commercialization times for product innovations.

#### 4.5. Implications

Fig. 2 provides a visual overview of the core CE barriers identified in our study and their possible interactions, which may ultimately hamper the transition to a CE. The identification of core barriers and negative chain reactions bears at least three implications. First, the CE is a difficult-to-implement concept; indeed, none of those we interacted with for this research had any problems in naming numerous CE barriers. This implication resonates with Kirchherr et al. (2017, p.228) who write that “[CE is not] a ‘quick win’, but a major long-term undertaking”. If the CE was immediately extremely profitable, cultural barriers like ‘Lacking consumer interest and awareness’ and ‘Hesitant

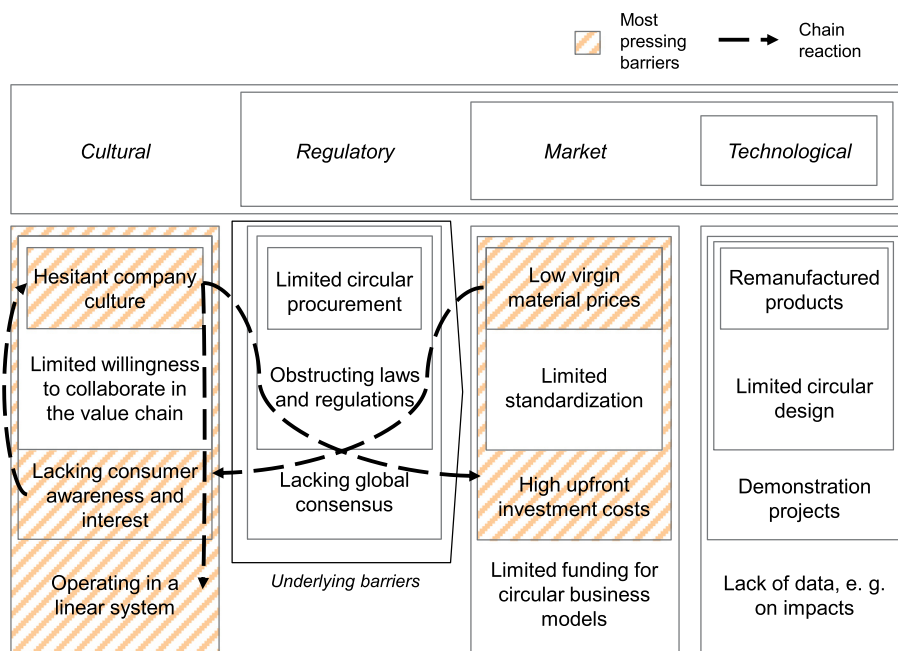


Fig. 2. Key CE barriers and their interaction.

company culture’ would not have emerged as key barriers in our study. Also, many more companies would have already embraced and adopted the CE approach in pursuit of higher profits. Yet, this may change in the future. While the enthusiasm regarding the CE seems to be restricted to the sustainable development community at this stage, according to our reading, this enthusiasm still suggests that the difficult-to-implement CE concept may be cracked eventually. After all, bursts of enthusiasm usually spur experimentation (Farla et al., 2012) and some of this experimentation may be ultimately successful.

Second, current governmental intervention strategies regarding the CE may not work. Indeed, many of these are focused on overcoming technological barriers (Dijksma and Kamp, 2016; European Commission, 2015), possibly influenced by the scholarly literature that outlines these as core barriers. For instance, numerous calls for proposals in the current ‘Horizon 2020 Work Programme from 2018 to 2020’ are geared towards research on the engineering aspects of the CE: EUR 30 billion will be allocated in total under this program from 2018 to 2020 (European Commission, 2017). Meanwhile, those CE practitioners we interacted with for this study claim that it is not engineering aspects and technological barriers that stop the CE transition. This leads to the third implication of this work.

Third, novel intervention strategies are needed to enable a transition towards a CE. This section has suggested that a key player that may accelerate the CE transition is the government. Many scholars before us have already portrayed the government as an essential actor for sustainable development, the intended outcome of the CE, e.g. Andrews and DeVault (2009), Carrillo-Hermosilla et al. (2009), Eckelman and Chertow (2009). The government would need to tackle those market barriers that appear as the most pressing barriers in our work: ‘Low virgin material prices’ and ‘High upfront investment costs’. Once these are tackled, e.g. via the elimination of fossil fuel subsidies or the introduction of financial incentives for circular investments, as outlined previously, the government may be able to replace the current chain reaction leading to a CE failure with one geared towards a successful CE transition. Admittedly, there is no guarantee that governmental interventions addressing the identified market barriers will then also break the identified cultural barriers, given the deeply rooted nature of culture that we discussed previously. However, the odds regarding a transition towards a CE may be raised significantly.

## 5. Conclusion

The CE concept is gaining momentum these days as an allegedly novel pathway towards sustainable development. Particularly the EU has endorsed the concept. Despite the growing attention and endorsement received, the CE has seen limited implementation so far. Those writing on the CE frequently blame the limited CE implementation on various barriers, with technological barriers having emerged in the literature as the alleged core barriers that impede the transition towards a CE. However, existing work on CE barriers is usually based on limited sample sizes, with the largest relevant study found, Shahbazi et al. (2016), being based on 41 expert interviews.

Our work contributes the first large-N-study on CE barriers to the literature, as far as we are aware (208 survey respondents, 47 expert interviews). We find that cultural barriers, most notably ‘Lacking consumer interest and awareness’ as well as ‘Hesitant company culture’, appear to be the most pressing CE barriers that slow down and possibly eventually derail the transition towards a CE. Meanwhile, none of the various technological barriers surveyed is among the most pressing CE barriers. Rather, the technological barrier ‘Lacking ability to deliver high quality remanufactured products’ even ranks as the least pressing barrier in our survey. With cultural barriers being cited most by the stakeholders we engaged with, we find that the CE is a concept that has not reached the mainstream yet. Currently, it seems to have sparked a lively interest mainly among sustainable development professionals.

We also identify possible interactions between barriers and chain reaction mechanisms that can lead to CE failure. For example, a chain reaction may be triggered by the difficulty of CE business models to compete in the market due to ‘Low virgin material prices’, which emerged in our study as a core concern for these keen on a CE transition. ‘Low virgin material prices’ can thus favor linear products, resulting in ‘Lacking consumer interest and awareness’ about CE products, which, in turn, leads to a ‘Hesitant company culture’ and ‘Operating in a linear system’ since companies cater to the consumers. Ultimately, the barrier ‘High upfront investment costs’ could be a symptom of the barrier ‘Hesitant company culture’, a seemingly technical excuse for not embracing CE investments, since our work also showcases that ‘Limited funding for circular business models’ does not rank among the most pressing CE barriers.

The government may need to step up if it wants to maintain CE's momentum. Targeted governmental interventions regarding the identified market barriers, e.g. the easing-out of subsidies that favor linear products, while, simultaneously, adopting policies that favor circular products such as reduced value added tax (VAT) for reparation, may provide a much-needed push for the CE. Even with this push, however, there is no guarantee that the CE concept will succeed. After all, culture is deeply ingrained and cultural barriers are thus difficult to overcome. The growing popularity of the CE concept among sustainable development professionals is encouraging in this context, though. This may spur experimentation which may ultimately succeed in identifying CE business models that reach the mainstream and thus ensure CE implementation success.

Admittedly, our study has several limitations. First, our sample size is still limited, particularly for policy-makers (which only 55 survey responses from policy-makers recorded via our work) and caution is thus warranted regarding the external validity of our findings. While our external validity may be greater than that of previous studies, we do not claim to present results that are representative in a strict statistical sense for the population at question. Furthermore, our work only provides a helicopter view regarding CE barriers in the EU. We remain silent regarding differences that may exist regarding CE barriers from sector to sector or business model to business model.

These limitations represent various viable avenues for future research on this topic. This future work may attempt to expand our sample size and/or explore CE barriers in specific sectors or business models. This would help to further refine the theoretical framework that we present in this study, while providing additional insights for policy-makers regarding suitable interventions to accelerate a transition towards a CE. The authors of this paper firmly believe that CE is a promising concept for sustainable development. However, careful analysis and critical discussion of CE barriers is needed to ensure that this concept will ultimately turn out to be a mainstream success.

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## Disclosure Statement

No potential conflicts of interests were reported by the authors.

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