Interactions of governmental policies and business models for a circular economy: A systematic literature review

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A systematic literature review on the interactions of governmental policies and business models for a circular economy

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Abstract

Governmental policies and business models are considered key elements for a transition to a circular economy. In current literature, there is a lack of understanding on how these two elements interact and how this understanding is used to accelerate the realisation of a circular economy. We shed light on this issue by conducting a systematic review of the literature in combination with a literature synthesis that looked in particular at interactions between governmental policies and business models not limited to a circular economy. We systematised the findings and then applied them to a circular economy context. The results show that there is a multitude of possible interactions between governmental policies and business models. The most commonly studied interaction is between command-and-control regulations and the value proposition element of business models. Soft policy measures like information- or communication-based policies or support mechanisms are less studied. Other findings suggest that there are certain types of dynamics which are useful to understand for policymakers and business model designers alike. A few examples of the synthesised insights are i) entrepreneurs may optimise their circular business models to exploit the policy framework, ii) technologies may lead to circular business model innovation forcing policymakers to adapt, and iii) policymakers may pay special attention to the needs of circular business models and support their competitiveness.

Keywords: business model; interplay; governmental policy; circular economy; systems perspective.

1 Introduction

Circular Economy (CE) receives growing attention in academia and societies at large. CE focuses on maximising the value and utility of resources and energy within production systems, based on the premise that natural resources are scarce, and that End-of-Life (EoL) products may retain some value (Ghisellini, Cialani et al. 2016). Having its roots in various scientific disciplines such as industrial ecology and environmental economics (Ghisellini, Cialani et al. 2016, Bruel, Kronenberg et al. 2019), CE is not solidly defined in literature, but follows a few general principles that appear consistently in multiple CE definitions. Kirchherr, Reike et al. (2017) reviewed 114 definitions of CE and presented the most common characteristics of CE as a concept, which is described as an economic system that replaces the concept of EoL with premises of total material use reduction; re-use of products by extension of product life through repair, refurbishment and remanufacturing; and finally recycling and recovering materials from production and consumption. CE is operationalised at multiple levels, including a micro level (products, services, companies, and customers), a meso level (eco-industrial parks and economic sectors), and a macro level (region, nation and beyond). The ultimate goal of CE is to promote sustainable production-consumption systems, through maintaining environmental quality, ensuring economic prosperity and socio-economic equity.

For CE to live up to its sustainability expectations, it needs to address a wide spectrum of aspects pertaining to production-consumption systems. There is a variety of research streams investigating CE (e.g. Tukker

2015) from different angles. The insights obtained thus far concern knowledge with, e.g., design of product/service (Tukker 2015), user behaviour (Camacho-Otero, Boks et al. 2019), business models (BMs) (Bocken, de Pauw et al. 2016) and governmental policies (GPs) (Milios 2018). For the transformative aspects of CE to take place, Planing (2015) suggested that a set of preconditions must be in place and interact with each other. Building upon Planing (2015), a systemic transition to a CE includes four fundamental building blocks:

1) materials and product design: wide adoption of eco-design principles in product design (Mont 2008) and careful material selection practices (Bakker, Wang et al. 2014), coupled with a purposeful product life extension mind-set that keeps products, components and materials at their highest possible utility and value (Russell 2018) in contrast to planned obsolescence principles (Maitre-Ekern and Dalhammar 2016).

2) Circular Business Models (CBMs): business offerings based on the provision of capturing residual value in products, encouraging take-back systems and circular product design (Nußholz 2017). This includes also business offerings based on function provision, e.g., leasing, sharing, pay-per-use and pay-per-result (Tukker 2015).

3) Reverse supply networks: integrating reverse logistics into conventional supply chains enabling companies to optimise their operations by making profit through the recovery of used products (Masi, Day et al. 2017).

4) Enabling conditions: there is a variety of enablers that may support a CE transition, broadly encompassing enabling policies, but can include regulations, financing, the support of markets for secondary materials or products (Milios 2018, Saidani, Yannou et al. 2018), raising consumer awareness (Michaud and Llerena 2011) and making effective use of digital technologies (Antikainen, Uusitalo et al. 2018).

In research and practice of CE, the systems perspective has been identified to be critical (Webster 2013, Pieroni, McAloone et al. 2019), where interactions between system elements play a key role. The building blocks of the CE need to interact with each other to enable a systemic shift towards more sustainable circular production-consumption systems (Planing 2015). Various literature sources evidence research efforts to analyse and understand the interactions between the different building blocks of the CE and offer a partial understanding of the systems' components and their interactions. For instance, there have been a few attempts to synthesise literature insights between product design and policy interactions in the case of the EU eco-design regulation (Bundgaard, Mosgaard et al. 2017), and the setting of mandatory product standards (Tecchio, McAlister et al. 2017). Similarly, scholarly literature studied the interactions between reverse supply networks and BMs (Bressanelli, Perona et al. 2018), and policies (Govindan and Hasanagic 2018). A systems dynamics approach was used by Franco (2019) to synthesise literature insights of product design and BMs. However, what is currently missing is a systematic approach in combining insights of GPs and BMs; both are key integral components of the CE system (Tukker 2004, Planing 2015).

Several cases have been reported where the current regulatory framework failed to accommodate CE ventures that seemed economically and environmentally sound (Salmi, Hukkinen et al. 2012). Policies related to CE are being drafted and implemented across the world with the objective to transform societies towards CE (Bocken, Olivetti et al. 2017, McDowall, Geng et al. 2017). Policy initiatives include but are not limited to: a) policies influencing product design (Maitre-Ekern and Dalhammar 2016), b) policies pertaining to manufacturing/provision of products and services, c) policies pertaining to consumption (European Parliament 2017), d) policies that address waste/EoL resource management (Dace, Bazbauers et al. 2014), and, e) policies supporting market development of circularly managed resources (McDowall, Geng et al. 2017).

Additionally, there is a substantial amount of literature analysing interplays between BMs and GPs in specific cases, e.g. renewable energy (Overholm 2015), banking (Jovanovic, Arnold et al. 2017) or e-

mobility (Christensen, Wells et al. 2012). The reported insights are often sector and topic specific, dependent on concrete cases, and described in a language specific to the respective academic domain. There is virtually no work that was performed for CE concerning this issue, and no work synthesised the findings of the different sectors and disciplines, either.

To fill this gap, the research objectives for this paper are to use a common framework to select, evaluate and categorise the literature pertaining to interactions between GPs and BMs, in different sectors in general (i.e., not limited to the CE realm), analyse their relevance to CE, and point out future research avenues in the CE context. The intention of the authors does not lie in creating a new theory to performing literature analysis within this article. This research is expected to contribute to the understanding of CE as a system, which includes the GP and BM elements as well as their relations. The theoretical contribution lies in showing how the high-level system elements are interlinked with reference to multiple examples that occurred in real life in various sectors. Specifically, the research will identify potential policy interventions that are enabling a shift towards CBM configurations as well as whether the CBMs are affected in their design and how they could respond proactively or reactively to GP pressures/effects. The insights will help better decision-making in a transition towards CE, both at business model design and public policy design.

The method chosen was a mixed approach consisting of a systematic literature review and a synthesis, which is a good fit for conceptualising the reported insights and for creating a foundation for advancing knowledge. In order to put this work into perspective, basic CE principles and frameworks are visited as well. Relevant literature included articles containing both BMs and GPs as parts of their research focus.

The remainder of the paper consists of the following. Section 2 presents basic principles of CE and strategies that can materialise CE configurations, as a background of analysis for the literature review results. Section 3 provides detailed information on the procedure adopted for the literature review in a transparent and reproducible manner. Section 4 presents the results of the systematic literature review followed by Section 5, which synthesises and discusses the findings in the CE context. Finally, Section 6 concludes the paper and provides the authors' suggestions for future research avenues.

2 Basic principles and operationalisation frameworks of the Circular Economy

Broadly, three core principles are derived from the various definitions that govern the CE cycles (EMF 2015a, Ghisellini, Cialani et al. 2016, Kirchherr, Reike et al. 2017, Reike, Vermeulen et al. 2018): a) conservation of natural capital, by creating an equilibrium of use between renewable and non-renewable resources; b) extended lifespan of resources through both biological and technical cycles, i.e. enhancing the circularity of resources and energy; and c) reduction of the negative effects of production systems. To operationalise these principles at micro, meso, and macro levels for the purpose of sustainable development, several strategies have been proposed in literature, establishing comprehensive frameworks.

Each of the CE frameworks has its particular focus. Potting, Hanemaaijer et al. (2018) propose the ten step strategies priority framework, introducing the 10R principle (refuse, rethink, reduce, re-use, repair, refurbish, remanufacture, repurpose, recycle, and recover) of priority action towards a CE. The framework further differentiates between the lifecycle stages, from the conceptualisation and design of a product to extending its useful life, and ultimately to the useful recovery of its material content or energy. In a similar conceptual framework, Reike, Vermeulen et al. (2018) identify the same CE strategies, only differentiating by adding a final recovery strategy, that of 'Re-mine', integrating concepts such as landfill mining and urban mining to the CE framework. Moraga, Huysveld et al. (2019) present a simplified version of a five-strategy approach to CE: 1) preserve the function of products or services provided by CBMs such as sharing

platforms or product/service systems (use- and result-oriented); 2) preserve the product itself through lifetime increase with strategies such as durability, reuse, restore, refurbish, and remanufacture; 3) preserve the product's components through reuse, recovery and repurposing of parts; 4) preserve the materials through recycling and downcycling; and 5) preserve the embodied energy through energy recovery at incineration facilities and landfills.

Other important aspects that go hand in hand with the proposed strategies for CE include the need for supply chain integration and coordination (Bressanelli, Perona et al. 2018, Milios 2018), as well as transparency and information exchanges concerning the quality of materials in products (Iacovidou, Velenturf et al. 2019). Winans, Kendall et al. (2017) identify exchange of information as one of the major constraints on the effectiveness of CE strategies. Finally, another approach, mostly targeting business actors outside academia, is the ReSOLVE framework (EMF 2015b). It introduces technological aspects such as Industry 4.0 and digitalisation/virtualisation of products and services (EMF 2015b). This framework is highly useful in CE practice and therefore will be employed to indicate the implications of this review to practitioners later in this paper (Section 3.4).

3 Research method

3.1 Overview

In order to reach the goal of this paper, a multi-step method shown in Figure 1 was used. This method is based on seminal works on systematic literature review (e.g., Tranfield et al. 2003). Steps 1 to 3 were the identification and screening of relevant papers, which represent some results in quantity (Section 3.2). Steps 4 and 5 focussed on interactions between BMs and GPs, requiring an elaborate in-depth analysis of the core papers (Section 3.3 and 3.4, respectively). In Step 6, in order to show the relevance of this work to CE, the identified interactions were mapped onto the ReSOLVE framework (Section 3.5).

This review work partly builds upon scoping studies (Arksey et al. 2005) and has a clear scope on the interaction of GPs and BMs, as earlier interaction with businesses (e.g., Sakao, Wasserbaur et al. 2019) informs the importance of interplays between GPs and BMs in the CE practice. It maintains the positive features of scoping studies such as knowledge dissemination, which is indicated especially by Step 6.

A challenge in systematic literature review in multi-disciplinary research, for instance, in defining constructs, is noted. Also, there is a tension in academia between the statistical benefits of using quantifiable aspects from the analysed pool of literature and the rich, quality analysis of more selected studies. This research method was operationalised with the major intention of making impacts in the real-world practice (following the idea of trans-disciplinary research, e.g., Sakao et al. (2018)) for presenting results in an accessible and usable form (Sandelowski, Docherty and Emden, 1971, p. 365): on the one hand, the scientific quality was maintained; for instance, the compliance with the general features of systematic literature review such as unbiased search and transparent process (e.g., Tranfield et al. 2003). On the other hand, this review work synthesises the underlying literature (Tranfield et al. 2003) and intends to provide transferable insights from different sectors in the form of "what could be useful for business leaders and policy makers in the CE context".

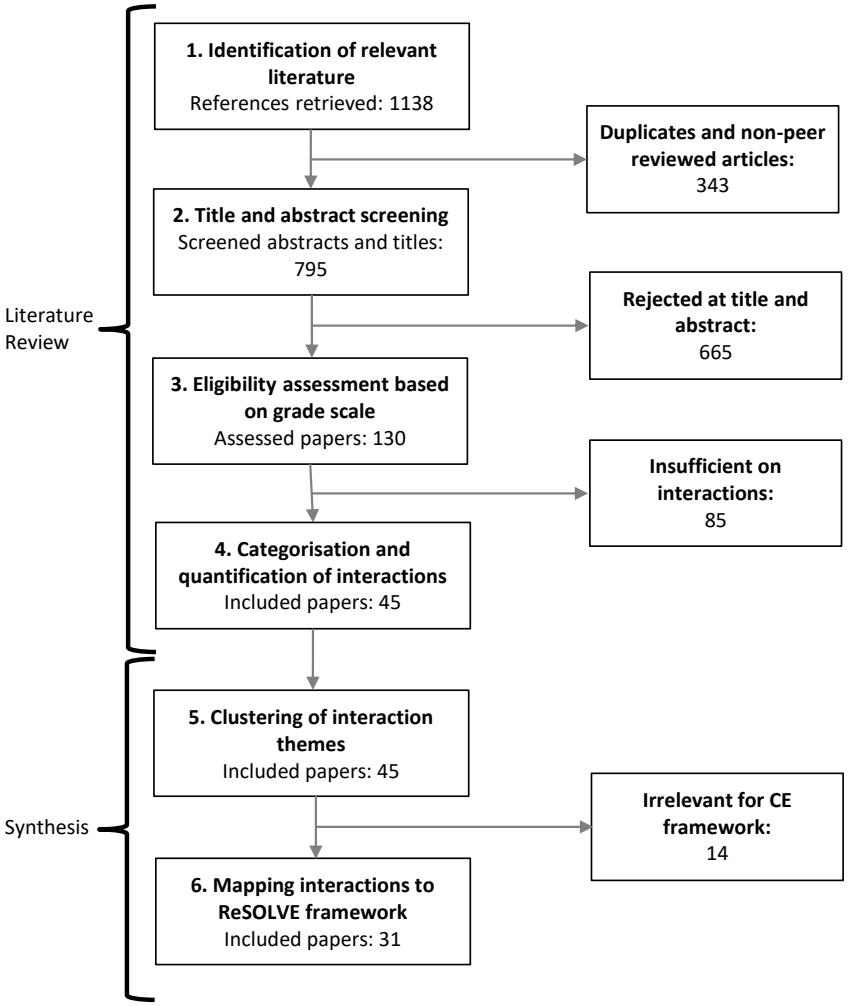

Figure 1. The process for the systematic literature review adopted in this research

3.2 Identification and selection of relevant papers (Steps 1 to 3)

Step 1 identified potential papers for further analyses. The search string's formulation was "business model" AND ("regulat" OR "policy"). The time period was not set. Only English language, peer-reviewed, academic journal articles were sought. The Web of Science Core Collection was chosen due to the journals' high impact factors. In Step 2 of the review process, the articles were screened to remove duplicates and to exclude papers with unfit title and/or abstract. In Step 3, the eligibility and relevance of the papers for further in-depth analyses was assessed, which involved full-text analysis. In order to decrease the subjectivity of the eligibility assessment, a relevance scale was introduced. The scale had the following grades:

1. **Irrelevant:** either GPs, BMs or both were not addressed to a sufficient degree. E.g. unclear usage of the BM concept or a vague description of policy impacts.
2. **Low relevance:** both GPs and BMs were part of the analysis, but the links between them were weakly explained or not clear.
3. **Medium relevance:** both GPs and BMs were addressed, and interactions could be discerned by the reader.
4. **High relevance:** both GPs and BMs were addressed, and interactions were described.

5. **Very high relevance:** GPs and BMs were addressed directly or indirectly, and links between them were clearly described. Interactions were clearly described in the article.

Once the entire sample was assessed for its eligibility, the papers with high and very high relevance were used for the remaining method steps.

3.3 Interactions between government policies and business models (Steps 4 and 5)

At the core of this review are the interactions between GPs and BMs. These interactions were analysed quantitatively and qualitatively. For the quantitative analysis in Step 4, a framework consisting of policy categories (see also Taylor, Pollard et al. (2012)) and BM aspects was created (see Table 1). The categories of the GPs were:

- **Legislation/regulation:** mandatory obligations or restrictions imposed by a governmental body upon an individual or an organisation.
- **Economic/fiscal:** policies changing the incentive structure of an individual or an organisation through taxes, tariffs, subsidies, tradable rights, etc.
- **Information- or communication-based:** information provision influencing behaviour of individuals or organisations.
- **Support mechanisms and capacity building:** policies aiming for the generation of knowledge and research, conducting demonstration projects, the dissemination of knowledge, and the facilitation and building of networks and cooperative problem solving.

GPs may be implemented on several governmental levels, from the municipality level to the supranational level (e.g. EU).

The BM categories were similar to those used by Osterwalder, Pigneur et al. (2005). Osterwalder and colleagues divide a BM into nine components: value proposition, customer segments, customer relationships, key resources, key activities, distribution channels, key partners, cost structure, and revenue model. BMs will be further discussed in Section 4.1.2.

GP-BM-interactions are organised in a framework consisting of the nine BM categories and four GP categories. The framework is depicted in a matrix (Table 1), which made it possible for the researchers to categorise interactions between GPs and BMs. Examples of interactions may be effects of transparency regulations on cost structures in the banking sector (Jovanovic, Arnold et al. 2017) or revenue effects of feed-in-tariffs to foster renewable energy-related BMs (Overholm 2015). The interactions were identified and assessed; finally, each article was assigned to an appropriate cell in the framework as shown in Table 1 (see also Appendix).

In addition to mapping the interactions quantitatively, a more qualitative synthesis of the results was conducted in Step 5. The authors searched for characteristics and reoccurring patterns in the reviewed articles resulting in a clustering of themes. These analyses were guided by the intention to understand how GPs influence BMs and vice versa. The discovered insights are presented in Section 4.2.

3.4 Contextualisation for the circular economy (Step 6)

This paper adopts a combined approach, systematic literature review and synthesis as the research method (as depicted by Figure 1). The literature covered includes articles outside the context of CE; yet the insights on the interplays between BMs and policies in general are potentially applicable to those in the CE context. In fact, many articles were very relevant in the CE domain, for example, those related to renewable energies. In order to contextualise the findings around the interactions between BMs and GPs, the most relevant papers were mapped onto the previously mentioned ReSOLVE framework.

The ReSOLVE framework was deemed a fitting approach in the contextualisation of GP-BM interactions within a CE perspective due to its business-oriented nature which is rather applicable than purely theoretical.

The three principles of the CE, as outlined in Section 2, are translated into six business actions in the ReSOLVE framework: regenerate, share, optimise, loop, virtualise, and exchange (EMF 2015b). *Regenerate* refers to regenerating and restoring natural capital by prioritising the restoration and resilience of the ecosystem. *Share* refers to maximising asset utilization, pooling the use of assets and reusing/adapting assets. *Optimise* refers to system performance and includes prolonging an asset's life, decreasing use of resources and implementing reverse logistics to increase the overall resource efficiency of the system. *Loop* refers to keeping products and materials in cycles, prioritizing higher value loops such as remanufacturing and refurbishing of products and components, followed by the recycling of materials. *Virtualize* entails substituting resource use with virtual use, replacing physical products and services with virtual services, replacing physical with virtual locations and delivering services remotely. *Exchange* is about using flexible design and use, leasing and performance-based models to deliver same function with reduced material inputs and/or environmental impacts. This can be done by using alternative material inputs, providing service-centric models, and using advanced technology where appropriate.

To contextualise the results of the literature review, the identified interactions of BMs and GPs are categorised into these six CE action areas and their potential in affecting changes is discussed. Section 5 presents the results of this mapping exercise.

4 Results

4.1 Quantification of interactions (Step 4)

4.1.1 Relevance and origins of publications

Following the description of Step 1, the query was conducted in January 2019 and initially 1,138 publications were found. Duplicates and non-peer reviewed articles were removed.

In Step2, 795 articles were screened by title and abstract. In the third step, the remaining 130 articles were assessed by their full text. The irregular usage of the terminologies throughout the articles required additional efforts for evaluating their relevance. The relevance scale (see Section 3.2) was found to be useful for assessing the eligibility of each article. Out of these 130 papers, 70 were irrelevant and not eligible for further analyses, 14 ones had medium relevance and one had low relevance.

For Step 4, out of the remaining 60 articles 45 were found to be highly relevant or very highly relevant. These 45 relevant articles were analysed further.

There is an increase in the number of relevant articles published in recent years, from 1 article found in the year 2009 to 16 articles found in 2018, showing the increased relevance of the interactions between GPs and BMs. The sample records stem from a variety of scientific journals, which is unsurprising considering the thematic distance between the two core concepts of GPs and BMs.

4.1.2 Applied BM frameworks

Osterwalder, Pigneur et al. (2005) operationalised the BM concept with the *BM canvas*. It is the most widely used framework for analysing the BM concept. In the following, conceptualisations of BMs suggested by other authors are referred to as well. Indicating its prominence in literature, the BM canvas was customised for a multitude of sustainability-oriented ventures throughout the reviewed articles.

The majority of authors used the BM concept without clearly defining it. At times BM was used synonomysly for revenue model (Karneyeva and Wustenhagen 2017) or key activities (Angeli 2014). In

other places, BM referred to the value delivery, was used to distinguish between a product- or a service-based offering (Finne, Brax et al. 2013), or was used to describe the ownership-structure of the business transactions. Several authors used the BM term to refer to a kind of general business practice of the industry. From the group of papers which actually defined their understanding of the BM concept, most authors refer to the framework of Osterwalder, Pigneur et al. (2005). Along these lines, Engelken, Romer et al. (2016) found that the inconsistent use of the BM concept is hindering comparability of research studies and is suboptimal for scientific progress.

Within the reviewed articles four other BM frameworks were found besides the work of Osterwalder and Pigneur. The second most important BM reference used was Zott and Amit (2010). Zott and Amit define BMs as depicting *'the content, structure, and governance of transactions designed to create value through the exploitation of business opportunities'* (Zott and Amit 2010). A third BM framework can be found in Baden-Fuller and Haefliger (2013), who developed a typology of four dimensions to identify a BM: customer identification, customer engagement, value delivery and monetisation. A fourth framework is proposed by Walravens (2015). Walravens focussed on the control over the value network and how much value is generated by the network. Their BM framework consists of four aspects, the construction of the value network, the functional architecture including the role of technology in the value creation, the financial model describing how revenue is distributed in the network, and the value proposition. They did not focus upon the individual firm but on the entire network of firms.

4.1.3 The interaction matrix

In order to quantify the interactions found in the reviewed articles, the above-mentioned (see Section 3) categorisation for GPs and BMs was used. Table 1 organises the BM components in rows and the policy categories in columns. The interactions are unevenly distributed across the categories. The policy category legislation/regulation was observed to be most occurring in the reviewed articles. Legislation/regulation had most interactions with value proposition followed by cost structure and revenue model. Economic/fiscal policies also appeared fairly frequently in combination with value proposition, cost structure as well as revenue model. Interactions with information or communication-based policies were infrequently highlighted throughout the reviewed

Table 1. The interaction matrix presenting the frequency of interactions between GPs and BM aspects identified in the reviewed articles.

GP category / BM aspect		Legislation/Regulation/ command-and-control (L)	Economic and fiscal (E)	Information-based and communication-based (I)	Support mechanisms and capacity building (S)
1.	**Value proposition**	22	9	3	2
2.	**Customer segment**	11	4	1	1
3.	**Customer relationships**	6	0	0	2
4.	**Key resources**	9	0	0	2
5.	**Key activities**	15	4	0	3
6.	**Distribution Channels**	7	0	0	1
7.	**Key partners**	16	1	1	5
8.	**Cost structure**	16	11	0	4
9.	**Revenue model**	15	11	0	3

Note: See also Appendix; Table A1 including the paper references corresponding to the cell values.

articles. It was found that the largest group of papers investigated how regulatory frameworks affected BMs or how BMs were changed in order to adapt to new regulatory environments (see also Section 4.2.1). One interpretation of the uneven distribution of interactions might be that some BM components are harder to investigate than others; e.g., both the revenue model and the cost structure can be, to a fair degree, deduced from public materials. Second, in a free-market economy, the ways to influence a company's BM as a policymaker are limited. Financial policy incentives or disincentives are relatively common instruments to influence company responses. The identified interactions were unevenly distributed across the policy categories and gravitated towards legislation/regulation. This may reflect the permanent adaptation processes between GPs and BMs.

Throughout the review, certain BM components were more commonly affected by GPs. More literature was found that reported on the interrelations with 1) value proposition (e.g. governments' communication for promoting new technologies on smart grid technologies influenced on values perceived by citizens (Pereira, Specht et al. 2018)), 5) key activities (e.g. legislations for assessing carbon emission standards for building projects (Zhao, Chang et al. 2018)), 7) key partners (e.g. municipalities for collecting used products (Whalen, Milios et al. 2018)), 8) cost structure (e.g. feed-in tariffs for deploying photovoltaics (PVs) (Karneyeva and Wustenhagen 2017)) and 9) revenue model (e.g. PVs investors were exposed to revenue risk by changing GPs (Karneyeva and Wustenhagen 2017)) among the nine (9) elements adopted in this article (see Table 1). On the other hand, 3) customer relationships and 6) distribution channels were reported by substantially less literature to have interrelations with GPs. This provided different possibilities of interpretation, but value proposition, key activities, key partners, cost structure, and revenue model may be more suitable for GPs to be affected directly.

4.2 Clustering of interaction themes

This section is subdivided by the larger themes that emerged during the in-depth analysis. As the subsections do not correspond to the subject areas of the papers, papers rich in interactions may appear in multiple subsections. This way of organisation is deemed useful as documentation of the review results before moving to implications for CE (in Section 5).

4.2.1 Business models adapt to policy frameworks

Within the reviewed articles, several case studies described how a BM emerged in a given framework of GPs or how a BM was adapted to changes of such a framework. For instance, Angeli (2014) described the case of Indian pharmaceutical companies that after a change in an international trade agreement shifted from reverse engineering-based BMs to R&D-based BMs. From a different geographical region, Berti and Casprini (2018) described how an airport BM was modified due to a new regulation in the Italian airport industry.

Burger and Luke (2017) underlined the deep embeddedness of BMs in the regulatory framework of the distributed energy sector, policies "mould" BMs through given incentives. In this specific sector, BMs were influenced seemingly more by policies than by technologies. On the other hand, de Oliveira, Mendes et al. (2018) showed how specific BM choices of a juice machine producer in Brazil were affected by tax legislation, i.e., varying tax rates on renting, services or product sales (de Oliveira, Mendes et al. 2018).

In relation to transition of energy sources, several interesting cases were reported. Engelken, Romer et al. (2016) outlined the importance of appropriate policy drivers for renewable energy BMs; they recommend policymakers to create stable and reliable planning conditions for companies, governments should provide education opportunities in regions where needed, and developing countries should copy proven legal frameworks from countries with functioning frameworks. The authors also stress the need to fight corruption in developing countries. Karneyeva and Wustenhagen (2017) compared existing regulatory frameworks for BMs in three PV markets in Germany, Italy and Switzerland. They found that even in post-grid price parity situations, feed-in tariffs are very important to investors for limiting policy as well as

revenue risks. Similarly, Christensen, Wells et al. (2012) analysed the BM of an electric vehicle system in Denmark and documented its high dependance on the Danish pro-electric vehicle policy framework.

Furthermore, policymakers might consider the inabilities of small actors that have limited resources compared to larger ones. In a renewable energy context diversity of BMs is decreasing as smaller operations cannot keep up with policy changes or with the regulations compliance costs that are too high, e.g., compared to established energy corporations small collectively-owned solar farms lack the necessary resources (e.g., trading capabilities) in a post feed-in tariffs environment and are depending on policy stability and policy support in order to be able to compete and attract investments (Karneyeva and Wustenhagen 2017). Third-part ownership (TPO) BMs are reaching a broader customer group as consumers do not face the high upfront costs of solar PV installations. Policymakers can facilitate TPOs through a preferable tax code, policy stability, a reliable status regarding the legality of TPO BMs as well and manageable administrative costs, e.g. standardised contracts (Overholm 2015, Strupeit and Palm 2016).

New BMs in this sector are facilitated by liberalisations of the energy markets including the unbundling of energy systems, and a diversification from large centralised public utilities to many de-centralised and smaller private actors. For example, a liberal net metering regulation was key for the uptake and the legality of solar PV BMs in the Netherlands (Huijben and Verbong 2013).

In the Chinese renewable energy sector, regulatory hurdles exist for easy access of buildings to participate in energy aggregation markets, this goes along with a lack of incentives to implement energy control systems that make the energy demand of buildings more flexible (Ma, Billanes et al. 2017).

In the USA customers exhibit lower saving rates and higher frequency of changing residence. For value offerings in the USA are therefore immediate savings on the electricity bill are more interesting; regulations allowing for net metering as well as contracts that connect payments to house ownership are other crucial elements. The situation in Japan and Germany is different - on average saving rates are higher, and people move less frequently and customers more often have a long-term perspective for investments, which results in different loan conditions and necessary subsidies for banks (Huijben, Verbong et al. 2016, Strupeit and Palm 2016).

4.2.2 Co-evolution of governmental policies and business models

Within the reviewed articles, a group of papers applied a dynamic point of view. They showed that over time GPs and BMs change, co-evolve, and affect each other.

Dewitte, Billows et al. (2018) reported about three “regulation-adaptation loops”, that explained the peculiarities of the French retail market. Policymakers in France created a regulatory framework that despite opposing political interests lead to a higher concentration and a higher number of hypermarkets in the retail market than any other European country. The authors explained this development in which on multiple occasions, specific regulations led to BM adaptations that counteracted the policymakers’ original intentions. These types of considerations draw attention to the fact that these interactions are part of a dynamic complex system that can lead to unintended consequences. The authors state *“understanding the real impact of regulations on the business strategies and the BMs adopted by mass retailers requires a longitudinal approach”* (Dewitte et al. 2018, p.1006).

Dobusch and Schussler (2014) reported how the ongoing discourse around copyright reform as well as technological advances in the music industry, affected BMs over time and how incumbent players tried to protect their sales-based BMs against lax copyrights legislations as grown industries have built their BMs around copyright regulations. The opportunities given by digitalisation and the internet posed existential threats for incumbents and caused regulatory struggles that were promoted through a shift in society’s view on copyright, disruptive technologies, and BM innovations.

Finne, Brax et al. (2013) presented the case of Xerox, a company that due to antitrust issues was forced to de-servitize its BM. Hannon, Foxon et al. (2015) researched how governments can support energy service companies' BMs most efficiently and Plepys, Heiskanen et al. (2015) analysed how the changing European regulatory framework supported the transition from product-based to service-based BMs.

PV-based BMs were researched in multiple articles. Herbes et al. (2017) investigated the case of German renewable energy cooperatives whose BMs were endangered due to changes in the solar feed-in tariff system, as energy cooperatives find it difficult to cope with a change in the incentive structures. The authors highlighted the need for a closer collaboration between the cooperatives and policymakers. Energy cooperatives needed expertise and training in tendering systems, open market bidding systems etc. Huijben and Verbong (2013) presented three BMs that emerged around the Dutch regulation on net metering. Net metering is the balancing of electricity fed into and taken from the grid via the energy bill. The authors explained that in a regulatory framework with relatively low levels of subsidies, BM innovation was the crucial factor for the PV uptake in the Netherlands, and Huijben, Verbong et al. (2016) compared Dutch and Belgian regulatory environments for BMs in the PV industry. Interestingly, GPs designed to support PV, were found to enable as well as limit BM innovations in the two countries.

Entrepreneurs or BM developers can utilise the space between BMs and regulatory frameworks. New ideas can overcome or diminish existing regulatory barriers. Company decision-makers may be educated in how to exploit the regulatory framework their companies are operating in. Huijben, Verbong et al. (2016) recommend entrepreneurs should assess their BMs, identify where they can use the GPs to their advantage and adapt their BMs to optimally fit and exploit the regulatory framework. Airbnb, Uber etc. have shown how successful the conscious exploitation of legal loopholes can be (Biber, Light et al. 2017).

Another option is to, individually or collectively, alter the regulatory framework in their favour through lobbying, legal or other efforts (Huijben, Verbong et al. 2016). Especially in industries where CBMs need to compete against established linear BMs.

4.2.3 Regulatory support for BMs

Policy support can be an important aspect for BMs. Typically, subsidies or tax reliefs, but also support mechanisms, or information campaigns help companies, to be economically viable in the context of changing conditions as is the case in a transition towards CE. Creating protected niches provides valuable support for companies with innovative BMs that need to reach a certain level of maturity first in order to be able to compete in a later stage in the open market (Huijben, Verbong et al. 2016). For example, Jovanovic, Arnold et al. (2017), were clear about the strong impact of regulatory changes on cost structure, revenue model and value creation of cooperative banks. Other banking BM-related topics were effects of heightened liquidity regulations on banks' BMs (Paulet 2018) or the robustness of ethical banking in the economic crisis (Paulet, Parnaudeau et al. 2015).

However, not every BM requires special governmental policy support: many BMs function commercially, without specific governmental support.

Karneyeva and Wustenhagen (2017) compared the regulatory frameworks for BMs in three PV markets in Germany, Italy and Switzerland. They found that without risk-reducing policy support, grid parity of PVs did not suffice to keep private investments up. The authors argued for upholding certain levels of policy support. Muller and Welpe (2018) compare the regulatory frameworks of Australian and German multi-household electricity storage systems. Low grid fees and flexible access to distribution networks facilitated community level storage systems. These comparisons provide accounts for different BMs building upon different policies.

Long-term stability of GPs is critical in some businesses: e.g., local energy management in the energy transition (Facchinetti, Eid et al. 2016), development of solar electricity markets (Overholm 2015, Karneyeva and Wustenhagen 2017) and biogas produced from organic wastes (Karlsson, Halila et al. 2017).

BMs requiring large investments and therefore, long payback times will benefit from long-term stability of governmental support.

4.2.4 Public-sector BMs

Within the reviewed sample, six papers featured a close connection of a governmental or public sector organisation with the BM concept. The topics were either related to BMs of public sector organisations or public-private partnerships, in sectors like large technical systems (Kanda, Sakao et al. 2016) and urban transportation (Zhang, Zhang et al. 2015). The authors addressed diverse topics, such as environmental technologies (Kanda, Sakao et al. 2016), city transportation (Walravens 2015, Zhang, Zhang et al. 2015, Li, Zhan et al. 2016), public research organisations (Schillo and Kinder 2017) or public financing of sustainable companies (Benijts 2014).

The authors of three of the papers (Walravens 2015, Kanda, Sakao et al. 2016, Schillo and Kinder 2017) tried to advance existing BM frameworks by including public actor-specific aspects. Kanda, Sakao et al. (2016) showed how important public-private partnerships can be for the diffusion of large-scale environmental technologies. For large technical systems, such as waste treatment plants, municipalities typically play an important role either as suppliers or as customers. While underlining the socio-technical and trans-organisational character of large technical systems, Kanda et al. synthesised BM literature and defined six so-called "business concept components": market, finance, resources, activities, partnership and ownership and responsibility, which can be interpreted as a BM framework. The authors claimed that the business concept offers opportunities for system-wide environmental improvements in contrast to organisational-level improvements that might occur through a normal BM approach. Furthermore, this new BM framework for large technical system improves planning of diffusion of environmental technologies with regards to regulations, public private partnerships, and legitimacy.

Walravens (2015) departs from a BM framework revolving around control of the value network and value creation and extends it with the concepts, "governance" and "public value" to adapt it to BMs of services offered by cities. Schillo and Kinder (2017) focused on BMs for public research organisations. The authors call the BM framework "impact model". The impact model helps to show various ways of how external actors interact with public sector organisations in the field of technological innovations. The authors presented a case of a Canadian public sector research company and reason that their BM framework could be used across multiple industry sectors. Dissimilar to other articles, (Benijts 2014) used the BM concept to explain the failure of a governmental corporation founded to finance sustainable companies. The author highlighted that a certain flexibility in the asset allocation was missing for success.

Two articles (Zhang, Zhang et al. 2015, Li, Zhan et al. 2016) used the BM concept to explain the functioning of transport-related public-private partnerships in China. Li et al. (2016) underlined how useful the integration of business innovations and governmental regulations is for the facilitation of electric vehicle deployments in cities. The authors used a multi-actor perspective as well as the BM canvas for an analysis and comparison of government-enterprise interactions for electric vehicle deployments (e-taxis and e-buses) in China. Zhang et al. (2015) presented a study of public bicycle sharing systems in five Chinese cities. City governments are highly important in this sector. Cities provide subsidies and administrational support to the typically privately-owned bicycle sharing companies and exercise direct influence on the cost structure of such BMs.

4.2.5 Technologies' relations with interplays between GPs and BMs

Technologies sometimes play a role in the interplays between BMs and GPs in different ways. First, the influences of technologies were observed and discussed when new BMs challenge GPs. Biber, Light et al. (2017) made an extensive discussion of the interplays, especially on the platform economy. They categorised regulatory tools as a response to new BMs: block, free pass, apply old regulation, and develop new regulation. They then discussed new BMs such as Airbnb and Uber, which were triggered by new

technological development. They asserted that regulators should strive to be neutral between incumbents and innovators and not favour one form of business organisation over another. Initially, Airbnb was an innovative BM that exploited a regulatory gap, namely, housing regulation allowing tenants to sublet their flats for a small number of times tax-free. Policymakers were then forced to adapt to unintended consequences like rising housing prices in areas with a high use of Airbnb, or decreased tax revenue from the hotel sector (Biber, Light et al. 2017).

Second, in contrast, technologies are in some cases expected to be developed by the interplays between BMs and GPs. Concerning autonomous vehicles, various BMs exist, from the traditional private ownership model to the access-based model, e.g., mobility as a service. These BMs and their related governmental regulations regarding liability, safety, and legislation have influenced one another. Subsequently, according to (Skeete 2018), automobile regulators are already in anticipation of a technology to become disruptive, e.g. fully autonomous cars by 2030.

Third, the literature describes a situation where technologies, BMs and GPs can be developed simultaneously. This can be regarded as a hybrid of the first and second ways explained above. Mwangoka, Marques et al. (2013) addressed a situation in the telecommunications sector, in particular, the potential exploitation of the unused spectrum resources of TV white spaces to deploy more wireless services. This was motivated by the uncertainties from technologies, BMs and regulatory policies that hindered the take-off of TV white spaces exploitation. They proposed a specific solution called the bicameral geo-location database together with four deployment scenarios, which were then evaluated from technological, business and regulatory prospects. This case implies that a certain technology can create relevance to the interplays between BMs and GPs.

5 Implications for circular economy

5.1 Overview

The purpose of this section is to connect the GP-BM interactions directly to CE. The chosen approach was to assign each paper to one of the six CE action areas of the ReSOLVE framework.

The largest group (17 out of 45 papers) refer to *regenerate*, i.e., the use of renewable resources and greater inclusion of biological cycles in production processes. Five papers were located next to the topic of *sharing* and related to the sharing economy. All three papers related to *optimise* dealt with energy service provision. Four papers were found to be related to *loop*, which is a category that addresses aspects that facilitate looping of products and materials through design, behavioural or technical measures. No paper was identified to relate to the *virtualise* category. Two papers exhibit interactions relevant for *exchange*, i.e., the replacement of materials and technologies with more resource-efficient alternatives. Finally, 14 papers could not be related to a CE topic as such, for example, effects of regulatory changes on the banking sector etc.

The interaction matrix (Table 1) has indicated that the type of GPs most affecting BMs are direct measures including regulatory/legislation command-and-control instruments, while economic, information and support instruments are influencing to a lesser extent. In particular, information GPs had the weakest impact and are not considered sufficient to influence a BM on their own. In terms of BM components, GPs affect most often the ‘value proposition’, ‘key activities’ and ‘key partners’ and to a high degree the ‘cost structure’ and ‘revenue model’. Table 2 describes the information of the GP-BM interactions found in literature within the context of CE. The interactions are presented on the ReSOVLE framework and for each category the type of interaction and the CE application potential is expressed, taking into account the contextual and descriptive results of the previous section. More details on each ReSOLVE category are presented in the following sub-sections.

Table 2. Summary of interactions between governmental policies and business models in literature related to circular economy according to the ReSOLVE framework. Discussion points about the potential of practical application and implications are also presented.

CE element	Outcome/aim	GP-BM interaction in literature	CE potential application and related implications
Regenerate	*Shift to renewable energy and materials*	In a case of energy service providers, the determinants of the successful business deployment were affected by financial incentives; policy consistency; streamlining and facilitation of legal-administrative processes; and liberalisation of the sector (Huijben and Verbong 2013) - 8L and 9L.	In the transition to a CE, policy consistency and simplification of administrative requirements are high priority policy interventions, while financial incentives and regulatory framework liberalisation are viewed with caution, since the signals of such interventions are not always clear (Milios 2021). There is a variety of financial incentives, e.g. fiscal instruments and direct subsidies (or feed-in tariffs), both having related down-sides. Subsidies can create an artificial business environment which would not be viable in a long-run, if not tested in market competition. On the other hand, taxes are only second-best policies for addressing resources due to their inherent impreciseness (Domenech and Bahn-Walkowiak, 2019). Therefore, a CBM could take advantage of a stable policy framework that states clearly the 'rules of the game' for a predictable time horizon; and of less complicated administrative requirements related to legal compliance and contracting. Economic instruments could act as a boost, especially at initial stages of BM transformation, but should not be relied upon for the longer-term development and establishment of a CBM.
		For electricity offerings, the way the electricity contracts are formulated played a critical role in the diffusion of renewables. Net metering and connecting payments to house ownership under different socio-economic circumstances lead to different policy support needs, e.g., bank loan conditions and subsidies (Strupeit and Palm 2016) – 8E, 8S, 9E, and 9S.	Socio-economic conditions and the market environment should be taken into consideration when developing a BM. When net savings and ownership of property is high in a certain context, then contracting and loan requirements must be different than in a context of low liquidity and fluid contractual obligations. Public subsidies might boost BM formulation and investment but this must be followed up by more concrete actions of BM deployment. Horizontal policy measures, in favour of CE activities, especially of a direct regulatory nature, might tilt the 'value proposition' and 'key activities' aspects of the BM more effectively than other policy approaches.
		For renewable energy BM diffusion, it is important that stable and reliable planning conditions for companies are in place. Also important are manageable administrative costs, e.g., standardised contracts (Overholm 2015) – 1L, 1E, 5L, 5S, and 7S.	Long-term stable regulatory framework as well as simplified administrative processes and standardised contracts can create the necessary environment for CBM implementation.

		In feed-in tariff systems, the gradual phase out of the financial support would be aided by stakeholders' training in management and trading of electricity markets (Herbes et al. 2017) – 5L, 8L, and 9L.	The importance of policy sequencing is also highlighted. A working BM can be aided by a variety of GPs according to its needs in a specific development phase. While feed-in tariffs aided the diffusion of the BM, its subsequent maintenance and proliferation is dependent in additional capabilities. Therefore, support in training and continuous improvement could be added in the policy mix for the CE transition.
		Control mechanisms are also important in regulating the energy demand of buildings (Ma et al. 2017) – 3S and 4L.	Although not a BM development mechanism, controls are always required to 'check' the functioning of the wider system in which the BM operates. Therefore, it is important to remember that effective control mechanisms can safeguard the effectiveness of applied policies as well as ensure a level playing field for all business actors in the economic system.
Share	*Maximize asset utilization*	In the case of bike sharing BMs the support of cities through investments, subsidies, infrastructure, advertising permits, police support etc. was key to the success of bicycle sharing in China (Zhang et al. 2015).	The papers related to the Share category show how important the collaboration between businesses and city governments is. Cities are the most appropriate actors to create the specific conditions needed by local innovative BMs to spur CE activities.
		In the Netherlands, a point of leverage in the BMs was that bike sharing systems were integrated within the wider public transport systems (van Waes et al. 2018) – 1L, 2L, 3L, 4L, and 7L.	In addition to providing enabling conditions for the development of CBMs, local authorities can integrate some services with public offerings, creating a circular ecosystem and legitimising the development and up-take of the BM from a wider public. This relation differs from the typical 'public-private partnership' in that the already established BM is integrated in the public system and not the other way around, where the public interest is investing for the development of a desired BM offering.
	Digitally enabled sharing of assets promote shared use	BM innovations cause policy disruptions. Accommodation sharing platforms took advantage of policy loopholes in the short-term rental regulations. Homeowners could occasionally rent out their places tax-free (Biber et al. 2017) Government supported facilitation of crowdfunding action as well as their regulation increased investment into renewable energies (Vasileiadou, Huijben et al. 2016), whereas in China crowd-funding was less successful as this	Legislation is not always ready to regulate emerging phenomena that have not been experienced before. In the case of sharing accommodation, the housing sector regulation was quite conservative, in a sense that it could not predict the effects of technological innovation in the housing market – a very traditional and predictable area of regulation. Several regulatory gaps were exploited by BM offerings creating conditions of intensive use and sharing of assets, creating increasing returns. Although such BMs have been criticised regarding their actual resource efficiency potential (Voytenko Palgan et al. 2017), nevertheless they have drawn attention to the disruptive nature of the 'platform economy' which in turn facilitated the laying down of rules that create a more just and transparent framework of operation for new entrants.

		financing vehicle is met with suspicion (Zhang 2016). – 1L, 2L, 3L, 4L, 5L, 6L, 7L, 8L, and 9L.	
Optimise	*Optimising system performance/ Decreasing resource usage*	Energy providers may switch from a sales-based to performance-based BM to increase the optimization potential for customer energy demand. Local planning authorities that implement low carbon strategies could enable this transition through a long-term strategic goal setting and regulation setting (Hannon et al. 2015) – 1L, 2I, 7L, 7I, 7S, 8L, 8E, 8S, and 9E.	Climate Plans and Circular Economy Strategies are increasingly becoming the norm for ambitious national, regional and local authorities which wish to advance their sustainability agendas. Within this strategic planning, public authorities have the ability to invest in upfront costs of low carbon equipment or subsidising the contracting process, promote informative policies and awareness raising, training for people to deliver and develop green contracts, and contract standardisation (Hannon et al. 2015). Therefore, there is a unique potential for systems' optimisation as long as public authorities act in a coordinated and scientifically sound way to respond to their environmental ambitions.
		Lack of a clear regulatory framework inenergy service companies incurs transaction costs, which is limiting business opportunities. Also, public efforts of standardising energy service contracts would limit costs (Klinke 2018) – 1I, 8L, 8E, 9L, and 9E.	Streamlining of legislation and simpler compliance and administration rules have the potential to reduce transaction costs and push down the overall operational requirements of companies, thus enabling them to redirect more resources and employ more capabilities towards a CBM.
		Through a reform in the energy sector in China, providers are allowed to keep a substantial share of the cost savings related to decreases of the customers' demand reductions (Zhang et al. 2017) – 1L, 2E, 5L, and 6L.	In this case, system optimisation is directly translated to money savings for the efficient company and thus acts as a directly accountable and highly visible incentive that can drive further operational optimisation and BM readjustments.
Loop	*Prioritizing loops (hierarchy)*	Support of BMs for extended product lifetimes through demonstration efforts and pilot projects to show the operational ability of second-life batteries and increase the willingness to pay for related offerings (Jiao and Evans 2016) – 1L, 1E, 2E, 5E, 7L, and 8E.	Innovation funding and support of research and demonstration activities is a fundamental policy support for bringing novelty into the market. In the transformative nature of CE, it is anticipated that a series of innovations, both in technologies and BMs, would be required.. This is highly relevant for high-risk developments, but also for streamlining softer aspects of CE, i.e., behaviour change and social acceptance.
		"Old for new" promotions of producers, within EPR systems, where old products are given back when new ones are	The reconfiguration of the EPR BM in this case allows for higher gains in material resource efficiency and revenues by increasing the collection of old products and prioritising the re-use and re-sell of the products instead of

		purchased improved the collection rates of old phones in China. The re-selling of these phones either to secondhand markets or into formal recycling process created extra revenue streams for producers (Tong et al. 2018) – 1L and 5E.	recycling. The EPR regulatory framework is embedded within the waste hierarchy principle, although the recycling option is mostly used due to cost efficiency in operations. However, cost efficiency does not always relate to resource efficiency and thus there is still significant potential for advancing to higher utilisation of resources within the EPR schemes. Potentially, additional measures would be required to improve the material efficiency of EPR, such as the introduction of fee adjustments in the system according to resource efficiency operations (Micheaux and Aggeri 2021).
		SMEs find it harder to comply with environmental legislation than larger organizations. SMEs are also embedded in broader supply chains that can make it difficult or impossible for them to implement circular activities (Rizos et al. 2016).	Regulatory compliance and control over suppliers is overextending the resources and capabilities of businesses which can respond according to their size and width of operations. SMEs are inherently unable to control circumstances away from their immediate BM. Simple compliance rules and explicit supply chain requirements (even with the use of labels or certifications) are required for an inclusive and just transition to CE which does not leave anyone behind.
	Remanufacture/refurbish products or components	A 'Gap-exploiter' BM for mobile phones takes advantage of a loophole in private insurance rules about proof of damage for reparations. In collaboration with an insurance provider, damaged phones are collected and refurbished for the second-hand market. This is possible only through the identified regulatory weakness due to high labour and infrastructure costs that would make this BM not competitive otherwise (Whalen et al. 2018) – 5L, 7L, and 8L.	In a business environment with significant cost constrains, a BM needs to manoeuvre accordingly to overcome these challenges, by opening up to 'key partners' and 'key activities' that might bridge the cost gap and increase competitiveness. However, this could also be achieved by targeted policy interventions that respond timely to such business economic constrains. In the case of high labour costs – a common phenomenon in developed markets – it is likely that a preferential taxation regime for CE activities could facilitate an upscale of such operations. Moreover, in absence of other cost reducing measures, municipalities or other regional authorities could share the burden of developing appropriate collection infrastructure for the acquisition of used products simpler and cheaper by adding specific collection systems for EoL products to the already existing recycling systems. Finally, municipalities could also introduce specific criteria for refurbished or remanufactured products in their procurement processes, thus offering also a further economic incentive for CBMs to develop and compete in the market with linear offerings (Whalen et al. 2018).
Virtualise	*Replacing physical products and services with virtual services*	No interactions identified in literature in relation to this CE activity.	N/A

Exchange	*Replacing product centric delivery models with new service-centric ones*	Antitrust rules reverse the transition from product sales to servitization in a case of imaging equipment (Finne et al. 2013) – 5L, 6L, 7L, and 9L.	Antitrust rules, intellectual property rules, ownership definitions under insurance contracts and public procurement rules have the potential to be formulated in a way that allows for a variety of product/service provision – not only within the traditional "product ownership" model. Further ways of fulfilling a function or service can be explored, i.e., through product-service system offerings (Wasserbaur et al. 2020).
	Replacing old technologies with new, including renewable materials inputs	Public subsidies for electric vehicles (EV) and tax exemptions for e-taxi operations promoted the diffusion of EV business offerings (Li et al. 2016) – 1L, 2L, 4L, 5L, 6L, 7L, 8E, and 9E.	Economic policy instruments, such as subsidies and tax exemptions have the potential to significantly affect the cost structure and revenue model of BMs. A preferential economic environment can reinforce CE business activities, but attention is needed in that the BMs become gradually competitive and can effectively substitute existing solutions, and to avoid remaining dependent on the economic subsidies for their survival.
		Public-private partnerships of regional authorities with local manufacturers favours the scale-up of EV offerings, however does not allow for the provision of alternative business offerings (protectionism) (Li et al. 2016) – 1L, 2L, 4L, 5L, 6L, 7L, 8E, and 9E.	Public-private partnerships can create the necessary stability conditions a BM needs to adjust in a new CE "reality" and potentially scale up to substitute existing business configurations. However, it is important to highlight the fact that phenomena of unlawful competition and protectionism can act against the goal of CE transition and be largely counterproductive in the long-run.

Note: papers cited in the column for GP-BM interaction in literature are associated with the sings according to the nine BM aspects and the four GP categories, where applicable; e.g., 8L means that the paper appeared in the row of 8. cost structure aspect and the column of L (Legislation/regulation/command-and-control) category of Table A1.

6 Conclusions

This paper presented one of the first works that analysed the interplays between GPs and BMs on the CE context by the systematic literature review, including literature synthesis. As interaction between GPs and BMs is no phenomenon confined to the CE, the bulk of the reviewed articles is not per se affiliated to CE; yet insights gained from outside the CE context are found useful for the CE. In concrete terms, mapping the interactions in a matrix consisting of four policy categories and nine BM components revealed that relevant recently published articles were increasingly focussed on interactions between regulations and value propositions as well as upon regulations and financial aspects of BMs. Studies using the BM canvas as an analytical tool have also revealed that, typically not all BM components are affected equally by GPs. Most exposed to policies were revenues and cost structure, command-and-control policies are more often researched than market policy measures. It was also found that nearly half of the relevant reviewed research dealt, to some degree, with technology and how technology affected the BM-policy nexus and that the majority of the reviewed articles were relatable to the topic of sustainability. It was further shown that the interactions between GPs and BMs are dynamic. These insights can be used for adapting GPs that are aimed to facilitate CEs in a more effective way. Therefore, suggested future research could apply longitudinal studies or even dynamic simulation methods to understand better the dynamics behind the interaction phenomena between GPs and BMs.

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Appendix

Table A1. The interaction matrix presents the interactions between GPs and BM aspects identified in the reviewed articles. This visualisation includes references. A simplified version is used in the main text (see Table 1).

GP category / BM aspect		Legislation/Regulation/ command-and-control (L)	Economic and fiscal (E)	Information-based and communication-based (I)	Support mechanisms and capacity building (S)
1.	**Value proposition**	(Liang and James 2009, Mwangoka, Marques et al. 2013, Hannon, Foxon et al. 2015, Overholm 2015, Plepys, Heiskanen et al. 2015, Zhang, Zhang et al. 2015, Jiao and Evans 2016, Kanda, Sakao et al. 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Yun, Won et al. 2016, Zhang 2016, Biber, Light et al. 2017, Burger and Luke 2017, Jovanovic, Arnold et al. 2017, Zhang, Jiao et al. 2017, Berti and Casprini 2018, Dewitte, Billows et al. 2018, Skeete 2018, Tong, Tao et al. 2018, van Waes, Farla et al. 2018, Yao, Zhong et al. 2018)	(Christensen, Wells et al. 2012, Overholm 2015, Zhang, Zhang et al. 2015, Jiao and Evans 2016, Zhang 2016, Burger and Luke 2017, de Oliveira, Mendes et al. 2018, Li, Zhang et al. 2018, Yao, Zhong et al. 2018)	(Klinke 2018, Pereira, Specht et al. 2018)	(Ernkvist 2015, Karlsson, Halila et al. 2017)
2.	**Customer segment**	(Mwangoka, Marques et al. 2013, Huijben, Verbong et al. 2016, Jiao and Evans 2016, Kanda, Sakao et al. 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Berti and Casprini 2018, Li, Zhang et al. 2018, van Waes, Farla et al. 2018)	(Jiao and Evans 2016, Burger and Luke 2017, Zhang, Jiao et al. 2017, Li, Zhang et al. 2018)	(Hannon, Foxon et al. 2015)	(Karlsson, Halila et al. 2017)
3.	**Customer relationships**	(Huijben, Verbong et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Paulet 2018, van Waes, Farla et al. 2018)			(Karlsson, Halila et al. 2017, Ma, Billanes et al. 2017)
4.	**Key resources**	(Engelken, Romer et al. 2016, Gabriel and Kirkwood 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017) (Kanda, Sakao et al. 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Ma, Billanes et al. 2017, van Waes, Farla et al. 2018)			(Karlsson, Halila et al. 2017, Li, Zhang et al. 2018)
5.	**Key activities**	(Finne, Brax et al. 2013, Angeli 2014, Overholm 2015, Plepys, Heiskanen et al. 2015, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Herbes, Brummer et al. 2017, Jovanovic, Arnold et al. 2017, Zhang, Jiao et al. 2017,	(Jiao and Evans 2016, Li, Zhang et al. 2018, Tong, Tao et al. 2018, Zhao, Chang et al. 2018)		(Overholm 2015, Lam and Yu 2016, Karlsson, Halila et al. 2017)

		Dewitte, Billows et al. 2018, Li, Zhang et al. 2018, Skeete 2018, Whalen, Milios et al. 2018, Zhao, Chang et al. 2018)			
6.	**Distribution Channels**	(Finne, Brax et al. 2013, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Zhang, Jiao et al. 2017)			(Karlsson, Halila et al. 2017)
7.	**Key partners**	(Finne, Brax et al. 2013, Mwangoka, Marques et al. 2013, Angeli 2014, Hannon, Foxon et al. 2015, Plepys, Heiskanen et al. 2015, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Jiao and Evans 2016, Li, Zhan et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Dewitte, Billows et al. 2018, van Waes, Farla et al. 2018, Whalen, Milios et al. 2018)	(Huijben, Verbong et al. 2016)	(Hannon, Foxon et al. 2015)	(Hannon, Foxon et al. 2015, Overholm 2015, Gabriel and Kirkwood 2016, Karlsson, Halila et al. 2017, Li, Zhang et al. 2018)
8.	**Cost structure**	(Huijben and Verbong 2013, Hannon, Foxon et al. 2015, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Marconatto, Barin-Cruz et al. 2016, Biber, Light et al. 2017, Burger and Luke 2017, Herbes, Brummer et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Dewitte, Billows et al. 2018, Klinke 2018, Paulet 2018, Pereira, da Silva et al. 2018, Platt, Workman et al. 2018, Whalen, Milios et al. 2018)	(Hannon, Foxon et al. 2015, Huijben, Verbong et al. 2016, Jiao and Evans 2016, Lam and Yu 2016, Li, Zhan et al. 2016, Strupeit and Palm 2016, Burger and Luke 2017, Serradilla, Wardle et al. 2017, de Oliveira, Mendes et al. 2018, Klinke 2018, Li, Zhang et al. 2018)		(Hannon, Foxon et al. 2015, Strupeit and Palm 2016, Karlsson, Halila et al. 2017, Muller and Welpe 2018)
9.	**Revenue model**	(Finne, Brax et al. 2013, Huijben and Verbong 2013, Satchwell, Mills et al. 2015, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Marconatto, Barin-Cruz et al. 2016, Vasileiadou, Huijben et al. 2016, Biber, Light et al. 2017, Burger and Luke 2017, Herbes, Brummer et al. 2017, Jovanovic, Arnold et al. 2017, Karneyeva and Wustenhagen 2017, Klinke 2018, Paulet 2018, Platt, Workman et al. 2018)	(Tuunainen 2011, Hannon, Foxon et al. 2015, Satchwell, Mills et al. 2015, Engelken, Romer et al. 2016, Gabriel and Kirkwood 2016, Huijben, Verbong et al. 2016, Lam and Yu 2016, Li, Zhan et al. 2016, Strupeit and Palm 2016, Burger and Luke 2017, Klinke 2018)		(Karlsson, Halila et al. 2017) (Strupeit and Palm 2016, Muller and Welpe 2018)

Note: The data of the references that are not cited in the main text are shown below.

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