European policies on circular economy:
A review of the literature

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Abstract

Circular economy (CE) can contribute driving our society towards sustainable development and promoting an ecological transition. However, companies have difficulties in implementing this concept because it prescribes a radical change compared to the current linear way of making business. Government intervention and a good set of policies are considered as the most effective manners to support firms in the adoption of CE. However, the European rules on circularity are not cohesive and, consequently, they are uncapable of encouraging companies in moving towards circular business models. Scholars are analyzing this issue and they found a consensus on how to solve certain challenges, but there are also several matters where there are disagreements. Therefore, there is little clarity on what legislative measures are the most effective in supporting the adoption of circularity among firms. This paper aims at overcoming this problem by performing a systematic literature review. The objective is developing an overall understanding of how European policies can support businesses in implementing circular economy. In particular, the aim is identifying the regulatory measures that are considered as relevant to support firms in adopting CE and the gaps in the current legislation that need further investigation. A research agenda is developed to further support the adoption of circularity among firms. This methodological approach allows bringing more clarity and coherence among EU laws on circularity, and the issue of the fragmentation that characterise these policies can be overcome.

KEYWORDS: Circular economy, Circular economy policies, Business practices, Ecological transition

JEL classification: Q5

# 1 Introduction

The last decades were characterised by huge technological and industrial progress that provided increased welfare to our society (Prieto-Sandoval et al., 2018). However, this rapid development was based on companies adopting linear business models, which lay their foundation on the “take-make-dispose” resource flow (Bocken et al., 2014). This approach was not keeping into consideration the limits of the environment and social issues that unsustainable industry practices may trigger (Antikainen & Valkokari, 2016; Murray et al., 2017). These facts caused several economic, social and environmental problems, and governments worldwide are currently trying to delineate strategies to overcome these challenges (Hartley et al., 2020).

According to some experts in the ecological transition field, circular economy (CE) can potentially contribute achieving sustainable development and solving these issues (for example Geissdoerfer et al., 2017; Prieto-Sandoval et al., 2018). This concept seems capable of promoting economic prosperity, improving business profitability and enhancing sustainability performances, while safeguarding the environment and social equity (Murray et al., 2017; Pinheiro et al., 2019). Nevertheless, implementing CE is complicated because it requires a radical change in the current way of making business (Bocken et al., 2018) and a solid legislative background that can support companies in this transition (Maitre-Ekern, 2021).

Scholars in this field consider government intervention and adequate set of policies as the most effective manners to promote the adoption of circular economy among firms and to turn them into a driver of an ecological transformation (e.g., Kosow et al., 2022; Milios, 2018; Milligan & O’Keeffe, 2019; Wilts & O’Brien, 2019). For this reason, researchers are analysing the EU legislation on circularity to delineate opportunities for improvement, and they came to the agreement that these policies on CE are fragmented, not coherent and unable to promote the drastic changes needed to implement this concept (for example Fitch-Roy et al. 2021; Schanes et al., 2019, among many others). Leipold (2021) and Fitch-Roy et al. (2020) explain that the current European policies on circularity are targeting different aspects of circular economy without being consistent with each other and, consequently, they are not supporting businesses in undergoing the radical shift needed to successfully implement circularity and promote an ecological transition. Therefore, governments are not adequately pushing companies in adopting circular business models and make their operations more sustainable (Marco-Fondevila et al., 2021; Schneider & Clauß, 2020). This fact has a direct impact on social and environmental issues, which current linear practices are causing, because industries are also not encouraged to address these matters (Maitre-Ekern, 2021; Murray et al., 2017).

As for the European policies on circularity, the publications on these field are fragmented and not cohesive. These papers are targeting the various aspects of circular economy without being consistent with each other and rarely they are focusing the implementation of CE as a whole. Moreover, regarding opportunities for policy improvement, there are certain matters where there is consensus, and others where there are disagreements. Consequently, there is little clarity on what legislative measures are the most effective in supporting the adoption of circularity among firms. This fact increases the complexity of this problem and hampers the creation of a better set of policies for circularity. Therefore, this paper aims at understanding what is consensual and not among the scientific community regarding the suggestions it provides to improve the European policies on circular economy. In this way, it is possible to grasp the matters on which scholars agree on, that can be considered as opportunities for improvement, and the ones characterised by a disagreement, which can be labelled as prospects for further research.

Furthermore, despite the fact that circularity is emerging as a global phenomenon, each geographical context has its own specific features, especially when it comes to the legislative scenario (Luo & Leipold, 2022; Ranta et al., 2018). For this reason, it is valuable to analyse the European legal environment and delineate opportunities for improvement that apply to this context while keeping in consideration valuable experiences coming from different geographical areas.

For the purpose of the study, a systematic literature review is performed to comprehend what are the EU circular policies currently in place and how scholars suggest improving them. In this manner, it is possible to assess how CE rules can be further developed to better stimulate businesses in implementing this concept and turn them into a driver of an ecological transition. Moreover, this paper aims at putting together the various contributions on this field to define where there is consensus and where there are disagreements. As a result, the policies instruments that scholars consider as relevant to drive companies towards CE are identified, and the matters that are not consensual can be discovered and further investigated. Consequently, a research agenda to further support the adoption of circularity among firms can be developed. This methodological approach allows bringing more clarity and coherence among EU laws on circularity, and the issue of the fragmentation that characterise these policies can be overcome. Therefore, the research questions (RQ) are:

**RQ:** How can the European policies on circular economy stimulate companies in implementing this concept?

* **Sub-RQ1:** What kind of policies instruments are considered as relevant to drive companies towards more circular practices?
* **Sub-RQ2:** What are the gaps in the current policy scenario that can be improved?
* **Sub-RQ3:** What can be a potential research agenda to further support the adoption of circular economy among businesses?

The findings of this research can be used by academia to comprehend what are the opportunities for improvement and the aspects that need further research in relation to the European policies on CE. In this manner, scholars can provide legislators with evidence on how to improve the current policies to encourage the adoption of circular business practices and promote an ecological transition.

The paper is organised as follows. Chapter 2 describes the methodology used for the research. Chapter 3 presents the concept of circular economy and its building elements. Chapter 4 depicts the results of the research. Chapter 5 and 6 presents the discussion of the systematic review, the limitations of the study, opportunities for further research and the conclusion.

#  Methodology

A systematic literature review was adopted to delineate the state of the art of the publications on European rules on circular economy. This methodological approach allows gathering updated knowledge on this field and get an overall understanding of what polices are currently in place and how they can be improved. The systematic review was performed with the support of the PRISMA methodology (Littell et al., 2008; Page et al., 2021).

In order to gather the highest amount of articles possible, research engines such as Google Scholar and Scopus were used. In addition, individual research on the ULB and Lund University libraries search engines were performed to get a wider number of publications. These articles were identified with the support of an extensive literature review on circularity. The most relevant and updated publications on this field were surveyed to grasp the main features, principles and practices related to this concept and to build a solid background about what CE entails. The identified characteristics of circular economy, presented in chapter 3, were used as key words to identify the articles related to the European legislations on circularity. In other words, the features of CE were used to collect literature on polices aimed at fostering the adoption of circular practices among firms. The key words used for identifying papers were “Policies”, “Regulations” OR “Legislation” AND “circular economy”, “eco-design”, “circular design”, “reusing”, “reducing”, “rethinking”, “remanufacturing”, “refurbishing”, “recycling”.

This methodological approach allowed gathering an initial amount of 1241 unique papers that were analyzed for screening. The titles and the abstracts were checked for relevance and 912 of them were excluded.

The next step was assessing, via scrutinizing the full text of the remaining 329 publication, if the articles were fitting the research objective. The following inclusion and exclusion criteria are adopted for the purpose of the study:

* Any publications providing suggestions on how to improve European policies on circular economy targeting firms are considered eligible for the study.
* Papers associated to improving regulations on circularity outside the EU but that provide recommendations applicable to the European context are included. Therefore, no geographical restrictions are applied.
* Peer-reviewed articles, books chapters and grey literature were included to widen the scope of the research.
* Only sources in English were included.
* Papers on CE regulations from 2015 onwards were deemed valid for inclusion. Polices on circularity are changing over time and were updated in recent years (e.g., the Circular Economy Action Plan published in 2015 was recently amended in 2020). Thus, only the latest publications were analyzed to avoid getting an outdated picture of the policies on circularity currently in place.
* Newspaper and web articles were excluded.

81 publications fitted these criteria and therefore were considered valid for the purpose of the research.

Because some of these publications are targeting CE policies indirectly and are not providing valuable information for the study, their full text was analyzed to understand if they were relevant for inclusion. A relevance scale with the following levels was adopted to achieve this aim:

* **Irrelevant**: the papers were not targeting CE regulations in an adequate way.
* **Low relevance**: policies on circularity were analyzed but in a vague manner.
* **Medium relevance**: rules on circular economy were addressed, and the reader could understand the impact they have on circularity.
* **High relevance**: CE policies were clearly presented and the impact they have on the adoption of circularity was adequately depicted.
* **Very high relevance**: the policies on circular economy were analyzed in an exhaustive manner and valuable suggestions for improvement were delineated.

Only the publications with *high* and *very high* relevance were considered relevant for the purpose of the study. 52 of them were satisfying these criteria.

Figure 1 depicts the literature identification process.



**Figure 1** – Methodological approach

The identified literature was analyzed and grouped according to the building elements of circular economy presented in chapter 3. The same paper may be related to multiple aspects of circularity. This approach allowed grasping how the legislation currently in place are addressing the various building elements of CE and delineate a state of the art about policies on circular economy. Figure 2 depicts the classification of the papers in a graphical form, and Appendix A shows the various publication according to the grouping criteria.

**Figure 2** – Classification of the papers in a graphical form

#  Circular Economy

Circular economy still does not have an agreed definition (Nobre & Tavares, 2021). There is the need to establish a good description of this concept to clearly define the objectives and roles of the stakeholders involved in circular activities (Luo & Leipold, 2022). Therefore, the author developed the following definition of CE for the purpose of the study (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Korhonen, Honkasalo, et al., 2018; Korhonen, Nuur, et al., 2018; Nobre & Tavares, 2021; Prieto-Sandoval et al., 2018; Wiesmeth, 2021):

*Circular economy is a concept that prescribes the creation of an economic system where no waste and pollution is generated at any stage of the life cycle of a product or a process. When a produce reaches the end of its lifespan, its resources are cycled back into industrial processes or ecosystems. Also, a circular system prescribes the use of renewable and clean energy, and sustainable consumption patterns. This economic system allows creating value at the macro, meso- and micro levels of the society, and can lead to sustainable development and social equity.*

The research on CE allowed the author identifying the pillars that build the foundation of this concept (see Table 1). This investigation also permitted to delineate the supporting factors that are facilitating the adoption of circular economy. Cooperation among stakeholders, the adoption of life cycle thinking (LCT), a better information sharing system, change in the consumption behaviour, and market-based instruments are fundamental building elements to promote a solid and effective implementation of CE (Dagilienė et al., 2021; Dalhammar, 2015; Ekins et al., 2019; Hartley et al., 2020; Jordan et al., 2012; Kirchherr et al., 2017; Maitre-Ekern & Dalhammar, 2019; Walden et al., 2021).

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| **Table 1**Description of the pillars of circular economy (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Korhonen, Honkasalo, et al., 2018; Korhonen, Nuur, et al., 2018; Nobre & Tavares, 2021; Prieto-Sandoval et al., 2018; Wiesmeth, 2021)  |
| **Circular economy pillar** | **Description**  |
| Design | Designing products for circularity. This pillar entails also the concepts of refusing and rethinking |
| Reduce | Reducing the use of resources and energy and avoid using hazardous substances |
| Reuse | Reusing the products or resources for the same or different purposes |
| Repair | Fixing the broken or malfunctioning parts of a product to extend its life span |
| Remanufacturing/Refurbishing | Bringing products back to a working condition so that they can last for another life cycle  |
| Recycling | Recovering the materials and chemicals contained in products to use them for the same or other purposes |

# 4 Results – Scholars’ perspectives on the circular economy policies

This chapter is presenting the result of the systematic review organized according to the pillars and supporting elements of circular economy. In this manner, it is possible to delineate how the current EU set of policies on circularity are targeting its implementation as a whole and delineate opportunities for improvement.

##  . Design

Tecchio et al. (2017) explain that designing products and services for circularity entails making them capable of promoting practices such as recycling, reusing, reducing material content, durability, upgradability, reparability, re-manufacturability, relevant material separability.

Stimulating circular design is considered as the most effective manner to implement circular economy, thus policies shall support the adoption of a better design for circularity (Baran, 2019; Whicher et al., 2018). These design improvements should be regulated by policies to support their adoption among the various industries and should be developed according to Life Cycle Assessment (LCA) principles in order to define the best circular actions for each product category (Dalhammar, 2015; de Römph & Cramer, 2020). These rules also need to be based on the waste hierarchy to prioritise reusing, repairing and remanufacturing instead of recycling, incineration and landfilling (European Parliament, 2008a; van den Bergh, 2020).

The Ecodesign directive is considered as an important starting point to promote the adoption of design for circularity but it presents several aspects that need improvements (Dalhammar, 2016; European Parliament, 2010). This regulation is mostly focused on energy matters and not on resource efficiency and, even though it has some requirements on life extension practices (e.g., reusability, durability, upgradability, remanufacturing), it never fully achieved the aim of improving the design for these circular practices because these criteria are not enough robust and stringent (Dalhammar, 2016; Polverini, 2021). In addition, the requirements related to designing for disassembly, promoting life span extension and availability of spare parts, allowed the Ecodesign directive improving the effectiveness of recycling and repairing activities, but they did not turn these actions into conventional practices (Mathieux et al., 2020). Furthermore, criteria on reuse of secondary materials and durability of products are still missing for a consistent number of sectors (Polverini, 2021). These gaps in the Ecodesign directive are also related to the lack of cooperation between policy makers and the relevant stakeholders because they have not been adequately involved during the policymaking process (Talens Peiró et al., 2020).

The Ecodesign directive can potentially be improved by implementing more stringent standards for circularity (Dalhammar, 2016; Flynn & Hacking, 2019; Hartley et al., 2020; Mathieux et al., 2020; Polverini, 2021; Stumpf et al., 2021; Talens Peiró et al., 2017, 2020; Tecchio et al., 2017). Standardization is a good manner to encourage the adoption of CE because it provides common language, requirements and tools that can facilitate a wider and more uniform adoption of design strategies (Tecchio et al., 2017). These facts assure that the entire value chain of a certain industry is address and improved in a sustainable and circular manner (Stumpf et al., 2021; Talens Peiró et al., 2017). Standardization is also beneficial because it helps reducing the uncertainty among resource flows and usage, and create common practices and protocols that can ease the implementation of circular economy (Flynn & Hacking, 2019). Furthermore, standardization can make products more durable and easier to repair, remanufacture and recycle (Purnell et al., 2019; Stumpf et al., 2021). Moreover, standards can promote designing goods using fewer raw materials and hazardous substances (van den Bergh, 2020), and a wider adoption of secondary raw materials (Dalhammar, 2016). In addition, Flynn & Hacking (2019) claim that standardization can favour waste, by-products and goods trade between different geographical areas because they harmonise products’ characteristics and design, and therefore favour circular practices and resources exchanges. To promote the adoption of more efficient and effective design standards, these shall be established by a top-down approach that disseminates them across Europe via adequate guidance on how to implement them (Hartley et al., 2020).

Finally, Milios (2020) explains that there is the need of planning the design regulations according to the trade-off between the various circular practices because a driver for a certain action may become a barrier for another. For instance, designing for recyclability can hamper the adoption of reusing and remanufacturing which are better practices from a waste hierarchy perspective (European Parliament, 2008a; Milios, 2018).

### 4.1.1 Extended Producer Responsibility (EPR)

When talking about design it is important to mention the Extended Producer Responsibility (EPR) scheme because it aims at improving design and waste management practices via making the manufacturers responsible for their products end-of-life (EoL) (Lindhqvist & Lidgren, 1990).

This policy is manly focused on recycling and was capable of increasing the recycling rates in a quantitative manner, i.e., the amount of recycled material, but not in a qualitative manner, i.e., quality of the recycled material (Kunz et al., 2018). Furthermore, it mainly pushes companies in improving their products design towards recyclability (Milios, 2018), while design for life extension practices (such as reusing, repairing, remanufacturing) are not targeted by this policy (Maitre-Ekern, 2021). These more sustainable circular activities are not stimulated by this scheme and an improved product design for circularity is not achieved (Purnell et al., 2019; Stumpf et al., 2021). Moreover, EPR did not help creating an adequate take-back system that allows manufacturers having a good flaw of post-consumers materials (Dalhammar, 2016). Therefore, EPR helped managing waste in a better manner but failed in fostering waste prevention and closing resource loops (Alaranta & Turunen, 2021).

Scholars suggest various manners to improve this scheme. Milios (2018) propose establishing a reward system for companies that are innovating their design towards circularity. Firms that are designing products for reusing and recycling shall pay less money, while a higher burden shall be given to the one that are not focusing on these aspects (Milios, 2018). Alaranta & Turunen (2021) recommend integrating the EPR with the REACH directive to make producers design products with less hazardous substances and to favour the recovery of these resources at the EoL. Another way to improve the EPR scheme is by improving the Producer Responsibility Organizations (PROs) system. Kunz et al. (2018) suggest making the sell of recycled materials more profitable, thus PROs can overcome market fluctuation, cover the collection costs and easily reach their waste gathering and recycling targets. Kunz et al. (2018) also recommend establishing a harmonised reporting and registration procedure, as well as EU level guidelines, that can reduce the administrative burden on producers and facilitate waste transportation and trading. These suggestions for improvement can promote the establishment of better collection and recycling targets in the EU and prevent waste from ending up in geographical areas where there are less strict policies and where, consequently, environmental and social problems can be exacerbated (Kunz et al., 2018). Finally, Maitre-Ekern (2021) proposes the creation of a new scheme called Pre-market Producer Responsibility (PPR). Its main objective is putting highly durable and repairable products on the market that can promote social justice and respect planetary boundaries throughout their lifecycle. Therefore, the author suggests switching the focus from EoL management to design. Design strategies for durability, reusability, repairability, remanufacturing and recyclability become the core of the scheme, switching the focus away from waste collection and recycling (Maitre-Ekern, 2021). Maitre-Ekern (2021) explains that making the PPR work requires turning practices such as repairing, remanufacturing and reusing into more profitable ones in order to make firms more willing to change their business models in this direction. Furthermore, it necessitates manufacturers to provide data on the lifecycle stages of their products and information on how to repair, remanufacture and reuse them. Finally, a more effective and efficient take-back system should be put in place to support repairing and reusing practices (Maitre-Ekern, 2021).

## . Reduce

Reduce is a circular economy strategy the prescribes decreasing the resource usage and avoid adopting hazardous substances (Alaranta & Turunen, 2021). The EU has established policies to manage and reduce hazardous substances usage (i.e., European Parliament, 2006, 2008a, 2008b). However, these regulations are not fully capable of assuring reducing resource and dangerous materials usage, and improve harmful substances management (Alaranta & Turunen, 2021; Bodar et al., 2018; de Römph & Cramer, 2020; de Römph & Van Calster, 2018). According to Alaranta & Turunen (2021), one of the main issue that make these regulations ineffective is that they are separated and not fully harmonised. The authors claim that this separation causes problems in handling waste and hazardous materials appropriately because it is complicated to manage these two waste streams together. Furthermore, the focus of the REACH regulation is on the production and use phase and, even if it provides suggestions on how to manage the end-of-life of waste, these requirements are not enough stringent to prevent hazardous substance from getting into the waste streams and circulating back into the biosphere or technosphere (Bodar et al., 2018). The REACH regulation also addresses dangerous substances separately, but it is not providing any guidance when they are mixed (de Römph & Van Calster, 2018). This fact causes problems in managing mixtures of hazardous substances that can potentially harm humans and the environment. Ultimately, these regulations do not provide any suggestions on how to find valuable alternatives to hazardous chemicals (Bodar et al., 2018).

To overcome these issues, a single regime of policies can be created to target the problem of waste, both hazardous and not, as a whole (Alaranta & Turunen, 2021). This unified regulation shall also address mixed substances and provide data on the composition of waste to favour the recycling process (de Römph & Van Calster, 2018). Alaranta & Turunen (2021) also argue that a greater disclosure of information about waste composition and presence of hazardous substances can be beneficial to the standardization of the waste streams, and consequently to the recovery practices and to ease traceability of the products and their EoL (Alaranta & Turunen, 2021). Moreover, Bodar et al. (2018) explain that the future policies should also provide suggestions on how to find valuable alternatives to the hazardous chemicals. In this manner, it is possible to drive innovation towards safer production and recovery practices and find valuable substitutes for harmful substances. Improvements on the policies can also come from recyclers because they can provide valuable insight on how to better manage hazardous substances (de Römph & Van Calster, 2018). Finally, these improvements should be accompanied by the establishment of a set of targets and a monitoring system that can allow achieving the reducing objectives (Domenech & Bahn-Walkowiak, 2019).

## . Reuse

Reuse is the circular practice that aims at using again a certain product or resource for the same or different purposes (Milios, 2021). Policies need to be improved to promote a wider adoption of reusing practices and stimulate entrepreneurship to create an adequate network of actors that can promote the adoption of this circular action (Ranta et al., 2018). However, reusing may not always be the best alternative form a sustainability perspective, recycling may be more beneficial for certain kinds of goods (e.g., home appliances) (de Römph & Cramer, 2020). Consequently, it is fundamental for policy makers to assess, via the adoption of LCA, for which families of products is better to reuse rather than recycle and establishing the right set of requirements for the various industries (de Römph & Cramer, 2020). A set of targets for reusing and a monitoring system can be put in place to assure the adoption of this circular practice (Milios, 2021). Furthermore, making virgin resources more expensive and introducing mandatory requirements for reusing in public procurement tenders may have a positive effect in fostering reuse (Milios, 2021; van den Bergh, 2020).

It is also of key importance to increase awareness about the importance of reusing and giving products back. In this manner, cultural barriers such as the one that makes consumers more willing to buy something new rather than second-hand can be overcome. Therefore, behavioral issues need to be addressed when developing policies for reusing (Ranta et al., 2018).

## . Repair

Repair prescribes fixing or substituting the broken on malfunctioning parts of a product to extend its lifespan (Kirchherr et al., 2018). The Ecodesign directive is prescribing that products need to be designed to favour repairability (European Parliament, 2010). Moreover, producers must provide data on minimum guaranteed lifespan, minimum time of availability of spare parts, optimization of life expectancy, and the possibility to upgrade the product (European Parliament, 2010). However, these requirements are not enough stringent to make repairing widely adopted and trustworthy (Svensson-Hoglund et al., 2021). Governments need to develop a better set of rules to overcome these challenges and promote the adoption of this circular activity (Milios, 2018). Policies that incentivise design improvements (e.g., for durability, repairability and easy disassemble) need to be established to foster the adoption of this practice (Kirchherr et al., 2018). However, two aspects need to be considered when establishing these requirements, i.e., life cycle impacts and profitability (Maitre-Ekern & Dalhammar, 2019). Having durable products is not always the best alternative from an environmental perspective, thus a life cycle perspective needs to be adopted to define the best circular practices (Maitre-Ekern & Dalhammar, 2019). The repairing practices also need to be affordable for consumers and profitable for manufacturers and repair shops. Providing spare parts for a reasonable price and give access to repair information are two effective manners to achieve this goal and making the various stakeholders more willing to undergo repairing activities and make entrepreneurs emerge in this sector (Milios, 2018). Another aspect that needs to be taken into consideration is that customers are more willing to buy new product rather than repair it. Therefore, making spare parts affordable can push clients towards extending the life cycle of their goods (Svensson-Hoglund et al., 2021). Maitre-Ekern & Dalhammar (2019) suggest creating a labelling system to provide an easy visual of the durability and life extension practices of a product. However, labels are a voluntary initiative so companies may decide not to adopt it or they can exaggerate on the expected lifespan of their products (Maitre-Ekern & Dalhammar, 2019). Thus, disclosing information on products’ features need to be adequately planned (Maitre-Ekern & Dalhammar, 2019). Engaging producers in the repairing initiatives and in the policy making process can be an effective manners to create better regulations while assuring their collaboration and transparency (Maitre-Ekern & Dalhammar, 2019).

## . Remanufacturing

Remanufacturing is the activity related to collecting goods that cannot be used any longer, separate their working parts and use them to bring products back to a working condition and make them last for another life cycle (Yang et al., 2016). To promote the adoption of this circular activity, it is of central importance of making producers willing to design products for remanufacturing (i.e., design for reverse channel, dismantling, lifecycle extension and upgradability) (Milios, 2018). Furthermore, policies that can support entrepreneurship need to be implemented (Yuan et al., 2020). In this way, the creation of an adequate network of actors which perform this practice and the take-back activities can be stimulated (Yuan et al., 2020). These suggestions for improvement need to be accompanied by policies related to the minimization of the total cost of acquisition and remanufacturing to make this activity more profitable for businesses (Yang et al., 2016). Consequently, companies will be incentivised to perform this practise, they will be less subject to the risk of cannibalization of new products and can make their clients willing to purchase remanufactured goods (Singhal et al., 2020).

Policymakers also need to overcome cultural barriers to make consumers and firms aware of the economic and environmental benefits of this practice. Policies can support companies in branding their remanufactured products as of good quality and affordable to shift the attention of the market towards this circular activity (Singhal et al., 2020).

## . Recycling

Recycling prescribes extracting the resources from a product when it reaches its EoL to use them for the same or other purposes (Talens Peiró et al., 2017). Most of the policies on circular economy currently in place focus on recycling (Ranta et al., 2018). However, this activity is almost at the bottom of the waste hierarchy (European Parliament, 2008a). Therefore, other circular practices shall be preferred and, only at the very EoL, waste can be sent to recycle. In addition, recycling is complicated because of the need of having high quality materials (Milios, 2018). To achieve this prerequisite, it is essential to establish an adequate set of policies and incentives to improve the collection, sorting and recycling technologies (Ranta et al., 2018). Nevertheless, recycling may not always be the least environmentally preferable alternative. It is important to assess for which product categories recycling can provide higher benefits than other circular activities (e.g., home appliances) (de Römph & Cramer, 2020).

To enhance the effectiveness of this practice recyclers shall be involved in the policy making process (Talens Peiró et al., 2017). These actors can provide valuable insights about the recycling activities and support the delineation of more effective policies (de Römph & Cramer, 2020). Legislators also need to intervene to improve the reliance on recycled materials because, nowadays, it is less commercially risky to use virgin resources (Purnell et al., 2019). Therefore, policies are needed to make secondary materials more economically acceptable and widely used (Baran, 2019). Furthermore, producers shall disclose data about how to dismantle their products appropriately to assure a good quality of the materials when they achieve the EoL (Milios, 2018). In this manner, a functioning closed loop of materials can be created and companies can be stimulated in moving towards circularity (Milios, 2018; Talens Peiró et al., 2017). For these reasons, policies should also aim at achieving higher targets for waste collection and recycling, and support investments in this direction (Beccarello & Di Foggia, 2018).

Finally, this practice can be eased by improving waste treading rules (Hartley et al., 2020). These policies should be modified to make it easier to exchange waste between different geographical areas when there are no health and safety concern involved (Kirchherr et al., 2018). Improving these trading rules can also have a positive impact in making companies less dependent on virgin resources (Beccarello & Di Foggia, 2018).

## . Stakeholders involvement

Cooperation among stakeholders is an essential enabler of circular economy (Hartley et al., 2020; Purnell et al., 2019). The circular system is composed of several actors that need to work in a cohesive manner to adequately implement circularity (Wilts & O’Brien, 2019). Each stakeholder needs to understand what role it needs to play in the system and what tasks it needs to perform to promote the transition towards circularity (Whicher et al., 2018). Therefore, communication, frequent interactions and cooperation are fundamental to make every key actor play an active role in the implementation of CE (Dagilienė et al., 2021). For this reason, it is important to delineate a transparent, trustworthy, and clear system to share the information that allow the various actors to communicate in an effective manner and coordinate the various circular activities (Braz & Marotti de Mello, 2022).

The main stakeholders that need to be involved to support the definition of a better circular system and policies are legislators, academia, manufacturers, importers, trade/business associations, EoL and life extension operators, market surveillance authorities, NGOs and consumers (Bodar et al., 2018; Flynn & Hacking, 2019; Mathieux et al., 2020;. Wiesmeth, 2021). Involving all these stakeholders allows gathering the perspectives of the main actors directly impacted by the CE policies and consequently define better laws (Fitch-Roy et al., 2020; Talens Peiró et al., 2017). Their contributions also permit defining valuable compromises and developing an adequate policy mix that can provide benefits to all the players involved (Wilts & O’Brien, 2019). Thus, it is important to define the right trade-offs to move our society towards circularity and sustainable development (Dalhammar, 2016). Stakeholder participation in policymaking should also be an iterative process to allow constantly revising and improving the rules (Talens Peiró et al., 2020).

Furthermore, moving from linearity to circularity requires achieving a global cooperation (Ekins et al., 2019). International organization such as the United Nations and the World Trade Organisation shall be involved to develop policies that can favour this process while respecting international laws and agreements (Wysokińska, 2020). These kinds of policies should also exhort sharing knowledge, experiences and best practices to support innovation and the alignment of circular performances among the various stakeholders operating globally (Milligan & O’Keeffe, 2019; Schanes et al., 2019).

Finally, according to Luo & Leipold (2022) to achieve a good cooperation among circular players, is fundamental to develop a clear definition of circular economy. In this manner, it is possible to make all the actors involved understanding what the common objectives are, what their roles in the circular system are, and make them work towards the same direction.

## . Life Cycle Thinking (LCT)

LCT and LCA are methodologies that allow analysing a product or a service from a life cycle perspective to assess which are the main environmental impacts and define opportunities for improvement (Dalhammar, 2015). These tools can support delineating the sectors and products for which is better to reuse, recycle or incinerate according to the environmental impacts they have throughout their lifecycle (Maitre-Ekern & Dalhammar, 2019; Wilts & O’Brien, 2019). Also, it allows understanding in which geographical areas the environmental impacts are happening, and thus can shape policies which target value chains that have multinational boundaries (Dalhammar, 2015). Therefore, LCA permits analyzing all the steps of an industry lifecycle and assess what is the best option for the different phases (Purnell et al., 2019; Syberg et al., 2021). In this manner, it is possible to define proper policies for the various product categories and their waste streams, and drive the various industries towards the lowest environmental impacts (Alaranta & Turunen, 2021). LCT also allows addressing the impacts of resources that have multiple lifecycles and therefore can support the development of adequate rules for them (Bodar et al., 2018). For these reasons, LCT should be more heavily included in the policymaking process (de Römph & Cramer, 2020; Hartley et al., 2020). However, even if LCT is currently used in EU policies, its full potential has not been disclosed yet because these rules are not always taking in consideration the lifecycle of products do define the best circular requirements (de Römph & Van Calster, 2018; Hartley et al., 2020).

Nevertheless, as Dalhammar (2015) explains, it is complicated to adopt LCA because this methodology is not easy to use and can provide unexpected outcomes or pinpoint deregulation needs. Furthermore, it may be complex to obtain the data needed to analyze the various lifecycle stages and consequently regulate all of them appropriately (Dalhammar, 2015). Finally, the author explains that it is necessary to apply LCA in an iterative manner and constantly update the results to keep them updated to technological developments (Dalhammar, 2015).

## 4.9 Data sharing

Stakeholder cooperation cannot be fully realised if the data needed to perform the circular activities are not shared in an adequate manner (de Römph & Cramer, 2020; Walden et al., 2021). For this reason, it may be beneficial for governments to establish policies aimed at creating an infrastructure for data communication that can favour the adoption and monitoring of circular practices (Purnell et al., 2019). This system shall allow companies disclosing information about their products and services to facilitate circular activities (Milios, 2021). Data about product hazardous substances, recyclability, reusability and repairability shall be provided to the various stakeholders to create a more efficient and safe market (Dalhammar, 2016; Milios, 2021; Svensson-Hoglund et al., 2021). In addition, this infrastructure can be adopted to share best practices, experiences and knowledge to foster innovation and the alignment of circular performances in the various industries (Milligan & O’Keeffe, 2019). This system should be easy to use and access, available at minimal or no cost, and should make data sharing transparent and reliable (Hartley et al., 2020). This approach should also not cause any legal issues when disclosing information about products and should not be burdensome for the various stakeholders (Talens Peiró et al., 2020). Therefore, it is important to involve experts in law, circular economy and Information Technologies (IT) to clearly delineate the data needed to develop a good and trustworthy system that can promote the adoption of circular economy (Talens Peiró et al., 2020).

The Digital Product Passport (DPP) is an instrument created by the EU that provides information about product’s origin, durability, composition, reuse, repair, dismantling, and end-of-life handling (Walden et al., 2021). Walden et al. (2021) explain that the DPP aims at capturing the environmental and social performances data in a standardized manner to allow the various actors involved in a certain value chain performing circular actions in a more efficient manner. Having data about circularity of products can enhance the transparency of circular activities and increase traceability and predictability of the flows of materials (Walden et al., 2021). This information can also be used by the various stakeholders involved in a certain sector to scale up circular practices and to make the entire system more solid and reliable (Walden et al., 2021). Therefore, a wider adoption of the DPP can support monitoring the respect of legal requirements, driving better design strategies, increasing sourcing of secondary material, stimulating a better planning and execution of the manufacturing activities, and helping decision-making on purchasing and financing issues (Walden et al., 2021). Therefore, this tool can be a valuable manner to share data that can support developing of better LCA studies and policies (de Römph & Cramer, 2020). Walden et al. (2021) also explain that to enhance the effectiveness of the DPP it is important to clearly define what data need be shared to favour circular activities and LCA studies while protecting intellectual property, find a standardized system of metric and measurements for evaluating the environmental impacts, and effectively provide data to consumers, recyclers, remanufacturers, and repairers to make them behave in a more circular manner.

## . Consumption behavior

Cultural factors and unawareness about the benefits of CE are two issues that are preventing this concept from being implemented (Kirchherr et al., 2018). Therefore, developing policies that can foster a behavioural change towards more sustainable and circular production and consumption it is of central importance (Domenech & Bahn-Walkowiak, 2019). These policies should target not only consumers but also firms (Wiesmeth, 2021).

Hartley et al. (2020) claim that circular economy marketing and promotion campaign shall be performed EU-wide to raise awareness among all the stakeholders involved in the market. Behavioural economics plays a key role in achieving this aim, and therefore should be adopted by policymakers in shaping regulations and initiatives (Wiesmeth, 2021). Furthermore, it is essential to nudge consumers towards circularity and make them behave according to the waste hierarchy (i.e., giving priority to reduce consumption, purchasing functionality rather than ownership, buying long-lasting, reused and repaired products, and eventually recycle or incinerate them) because, consequently, companies will be exhorted to adopt more of these circular practices (Maitre-Ekern & Dalhammar, 2019). Therefore, policy making should go hand in hand with social science studies to understand how people behave towards CE and how to make them more willing to purchase in a more responsible and circular manner (van den Bergh, 2020).

Kirchherr et al. (2018) claim that a manner to drive companies towards more circular behaviour is making recycled and reused raw materials less expensive. The researchers explain that if the price of virgin materials is low, then companies would be more willing to adopt linear practices. This fact has a direct impact on their clients that will be less exhorted to purchase in a circular manner, and therefore the manufacturers will keep working with linear business model to please them. Thus, lowering the price of circular raw materials can be a beneficial manner to stop this positive feedback loop and drive more sustainable production and consumption among firms and their clients (Kirchherr et al., 2018).

## . Market-based instruments

Market based instruments, such as alteration of taxes, incentives and subsidies, have been identified as drivers of circular economy (Baran, 2019; Jordan et al., 2012). Hartley et al. (2020) claim that it is highly beneficial to promote a wider set of incentives and funding to support firms in the transition towards circularity and stimulate intra- and entrepreneurship in this field. Furthermore, investment costs on circular business models can be lowered by governmental intervention by, for instance, providing financial support to companies that are investing in circularity (Kirchherr et al., 2018). Subsidies to research are also needed to foster technological innovation towards circular economy and the development of a better take-back system (Volk et al., 2019). Moreover, Hartley et al. (2020) and Kirchherr et al. (2018) explain that alterations to taxes on CE-based products are potentially beneficial for the adoption of circularity. The researchers suggest introducing a VAT relief for reused and recycled products, increasing taxation on linear-based products, and reducing corporate taxes for firms engaging in circular behaviours (e.g., reusing, remanufacturing and recycling).

Market-based instruments should also target secondary resources by lowering their cost. Circular raw materials prices are higher than the virgin ones, and thus they are less competitive in the market (Kirchherr et al., 2018). Subsidies are needed for recycled and reused materials to make them cheaper and more attractive for companies (Kirchherr et al., 2018; van den Bergh, 2020).

This chapter summarised the studies on the field of policies aimed at stimulating the adoption of CE among companies. Section 5 presents the discussion to these findings and answers to the research questions.

#  Discussion

The systematic review delineates the current state of the EU legislative scenario on circular economy. The discussion seeks to understand how these policies can be improved to stimulate companies in adopting CE. Therefore, this section is presenting the theoretical contribution of the research and it is answering to the research questions.

## . The debate on European policies on circular economy

The contributions from the literature have been analyzed to assess on which aspects related to improving the policies on circularity there is a consensus or not among scholars. A certain issue is considered as consensual when multiple publications are providing similar answers to it. On the other hand, a disagreement is classified as an aspect characterized by different approaches to solve it. In this manner, it is possible to assess how experts suggest improving the European set of rules to promote a wider adoption of CE among businesses, and what are the issues that require further investigation. Table 2 shows the result of this analysis.

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| **Table 2**State of the debate on policies on circular economy |
| **Circular economy aspect** | **Agreement** | **Disagreement** |
| Design | Develop a common and agreed definition and taxonomy on circular economy.Create better requirements for design for circularity and improve the Ecodesign directive.Develop a new set of standards to support the implementation of CE.Improve the EPR scheme to make it more effective in promoting design improvements. | How to effectively improve the Ecodesign directive.How to improve the effectiveness of the EPR scheme and if requirements for life extension practices need to be included.  |
| Reduce | Improve the current policies on hazardous waste management.  | Uncertainty about creating a unique set of policy for waste management or improve the current set of policies.  |
| Reuse | Promote this practice to make it mainstream.Make supply and usage of virgin raw materials more complicated and costly to make secondary materials more competitive. | How to stimulate entrepreneurship to create a network of actors that can perform reusing activities.How to promote a behavioral change to stimulate a wider adoption of this practice. |
| Repair | Support the adoption of this practice by making spare parts more accessible, by promoting cooperation among the stakeholders involved, and by changing consumers’ behavior. | How to disclose information about repairing to ease the adoption of this practice. How to stimulate entrepreneurship in this field.  |
| Remanufacture | Make producers more willing to adopt this practice and favor the creation of an efficient take-back system to stimulate the implementation of remanufacturing. Make consumers aware of the benefits of buying remanufactured products.  | How to stimulate entrepreneurship to create a network of actors that can promote the adoption of this practice. |
| Recycling | Creation of policies to support the implementation of a better collection, sorting and recycling system. Improve the recycling targets and reduce the usage of virgin raw materials.  | Product categories for which it is better to adopt recycling than other practices that are theoretically more sustainable (e.g., reusing, repairing, remanufacturing). |
| Stakeholders’ involvement | Favor stakeholders’ involvement to delineate better policies and an effective and efficient circular system.  | How to make stakeholders communicate and cooperate in an adequate manner. |
| Data sharing | Create an adequate and not burdensome data sharing system to support the cooperation among the relevant stakeholders.Establish a monitoring system for circular performances. | Kind of data that need and can be shared.The best IT tool to assist the data sharing system.Indicators that shall compose the monitoring system. |
| Life Cycle Thinking | Wider adoption of LCT in European policies to promote a better and more sustainable implementation of circularity.  | How to make companies and other stakeholders disclose the data needed for LCA studies.  |
| Behavioral change | Drive consumers and businesses towards behavioral change to make them willing to act in a more circular and sustainable manner and influence each other in a positive manner. | What policy instruments are effective in driving a behavioral change.  |
| Market-based instruments | Establish a set of incentives and disincentives to make companies adopt circular practices and reduce their dependence of virgin raw materials. | Instruments that are beneficial in stimulating intra- and entrepreneurship towards circular economy.  |

The analysis depicted in Table 2 provides a valuable insight on the ways scholars believe the current set of EU policies on circularity can be improved and what are the aspects of the rules on circular economy that need further consideration and research.

Experts in the field agree that an essential step to promote the adoption of CE among businesses is delineating a clear definition and taxonomy on circularity. In this manner, it is possible to make all the stakeholders involved clearly understand what this concept entails, what their role in the circular system is and make them work towards common objectives. The creation of an adequate definition and taxonomy can be also beneficial for promoting a wider adoption of design for circularity, which is considered as the first and most important aspect to implement this concept. Scholars agree that standardization is a valuable methodology to foster the adoption of circular economy and encouraging design improvements. Nevertheless, without a common definition and taxonomy of CE it is complicated to define requirements on products and their lifecycle. Furthermore, since current policies are not fully capable of pushing companies towards products design improvement, a better set of standards can be an effective tool to stimulate circular products design. Indeed, it is consensual that creating a common language on circularity is essential to define a better set of standards and support companies in designing products and services for circular economy. Moreover, academics agree that the Ecodesign directive is a valuable instrument to drive firms towards implementing a better design for CE, but they also explain that it needs improvements to be more successful in achieving this aim. They are suggesting ways to enhance its effectiveness, but there is not an agreement on them. Thus, additional investigation is needed to assess how to make this directive more efficient. There is also a consensus among the need of improving the EPR scheme to make it more effective in stimulating design improvements for circularity. However, scholars are uncertain about how to realize these developments. Therefore, further research is needed to delineate a way to improve this scheme.

In addition, scholars agree that policymakers shall support reusing, repairing and remanufacturing practices and reduce the dependence on virgin raw materials. A set of market-based instruments and policies can be adopted to make these circular activities conventional and profitable for both firms and customers. Academics also believe that the same kind of policy tools should be adopted to make recycled and secondary materials more affordable than virgin resource. In this way, it is possible to stimulate a wider usage of circular raw materials and support the creation of a functioning system that can provide those resources to firms and their clients in an efficient and profitable manner. Scholars also agree that entrepreneurship on reusing, repairing and remanufacturing shall be stimulated. The emergence of new businesses in these sectors can support the creation of a circular system that can stimulate companies in adopting these practices. However, there is not a consensus on how to effectively meet this objective. An enhanced system of incentives, tax deductions and fiscal policies can be beneficial in supporting entrepreneurship in these sectors. Nevertheless, more research is needed to assess how to successfully stimulate the emergence of circular entrepreneurs.

Scholars also agree that stimulating reusing, repairing and remanufacturing requires policies capable of promoting a behavioral change. Both firms and consumers need to be exhorted in changing their consumption behavior and be driven towards a more circular resource usage. Still, there is not a common agreed methodology to encourage this transition. More investigation is needed to adequately shift the stakeholder’s behavior towards a more sustainable one.

There is also a consensus on improving the current recycling system by creating policies that can support the implementation of a better collection, sorting, and resources recovery system. Furthermore, scholars claim that the recycling targets shall be made more ambitions to reduce the reliance on virgin raw materials. In addition, they stress the importance of safeguarding the health and safety of the stakeholders involved and minimizing environmental harms. For this reason, they agree on the fact that policies on hazardous substances shall be improved, but there is not a consensus on how to achieve this objective. More investigation is needed to assess if a unique set of rules to regulate both non- and hazardous waste can potentially overcome this challenge.

Another aspect that can promote the implementation of CE is creating a monitoring system. Scholars believe that the performance of the actors involved circular activities shall be constantly analyzed. In this way, it is possible to understand how firms are working towards CE, reward good practices and penalize the uncircular ones. Policymakers shall define the information that companies need to disclose to control their activities and a set of indicators for the monitoring system. This data sharing process needs to be transparent and reliable to permit a trustworthy examination of business circular performances. However, there is still not an agreement on these matters, and further research is needed to define an adequate data sharing system, and an effective set of indicators and incentives.

According to the experts in this field, the aforementioned improvements towards circularity require developing policies that can support the creation of a better network of actors. Manufacturers would be more willing to improve the design of their products if they become part of a system which can guarantee that resources are managed in a circular manner and that they can get benefits from the usage of secondary materials and from the adoption of reusing, remanufacturing, and repairing practices. Also, customers will be prone to behave in a circular manner if they can rely on a functioning system and, consequently, firms would be more willing to create circular designed products to please their clients. For this reason, academics stress the importance of implementing policies on circularity that can promote the creation of a solid network of stakeholders. They also agree that the relevant actors shall be involved in the policymaking process to achieve this objective. In this way, it is possible to include their contributions, and create more feasible and successful circular rules. Furthermore, their involvement in the policymaking process can potentially make them more willing to cooperate in the implementation of CE and constantly improve their practices. However, there is currently a debate on how to make stakeholders communicate and cooperate in an adequate manner and more research is needed in this direction.

Scholars also agree that legislators should adopt LCT more widely to delineate policies for circularity capable of stimulating an ecological transition. This methodology is fundamental to assess how to manage the lifecycle of the various products categories and establishing effective rules to promote the best circular alternatives for each sector. For this reason, more research is needed to define the most performant circular actions for each industry. In this manner, producers can comprehend what are the best design strategies and CE practices to disclose the full circular potential of their products and achieve high sustainability performances. However, performing good quality and valuable LCA studies requires disclosing data about products, their composition and lifecycle, and there is still not a consensus on how to make companies provide this sensitive information. Further investigation is needed to understand how to make firms share data about their products and services.

Establishing a monitoring system, creating a solid network of stakeholders, and performing good quality LCA studies requires sharing information among the various actors. Scholars agree that to achieve this aim policymakers requires creating an efficient and effective data sharing system. However, academia has not reached a consensus on how to develop this system. Therefore, more research is needed to provide policymakers with the adequate knowledge and tools to implement a sustainable and efficient data sharing system capable of supporting the adoption of CE and the realization of an ecological transition.

## . Policy improvements for a transformative circular economy

Circular economy can potentially provide economic, social and environmental benefits to our society via decupling industrial activities from environmental degradation while delivering good profitability and safeguarding social equity. This objective can be achieved not only because this concept offers a new way of making business (based on designing goods and services for circularity, reducing the reliance on virgin raw materials and hazardous substances, extending the usage of the resources embedded in products, recover the materials at the EoL, among other actions), but also because it prescribes the creation of a solid and effective cooperation among stakeholders, a shift in a consumption behavior, the analysis of sustainability performances from a lifecycle perspective, and the definition of clear targets that can drive the various players in the market towards the same goals. For these reasons, some scholars believe it is such a powerful tool to support the achievement of an ecological transformation. Furthermore, because an appropriate set of policies is considered as the most effective manner to push companies toward the adoption of circularity, it is fundamental to define effective ways to improve it. However, the European rules on CE are fragmented and not cohesive. Therefore, the analysis on the consensual and non-consensual aspects on EU circular economy policies allows defining the potential manners to make these laws more effective in promoting the adoption of CE among firms to turn them into a proactive driver of a sustainable and ecological development.

This study allowed defining the policies aspects that scholars consider as relevant to drive companies towards more circular practices. Chapter 4 and 5.1 present the various legislative measures deemed as fundamental to stimulate businesses in implementing CE. For this reason, those sections answer to the Sub-RQ1. In addition, the identification of the non-consensual aspects provides a clear indication on which regulatory aspects need further investigation. Thus, the Sub-RQ2 is answered via the recognition of those disagreements because they represent the gaps in the policy scenario that need additional research. In this way, it is also possible to address the Sub-RQ3 because these opportunities for further investigation allow delineating a potential research agenda (see Table 3) that can increase our knowledge on this field and provide additional support to companies in implementing circular economy. Replying to these 3 Sub-RQs allows answering to the main research question. The adopted methodological approach permitted to identify the policy elements that are key in driving firms towards adopting CE, the aspects of those rules that can be improved, and the one that need further investigation. As a result, this research provides clarity and coherence among EU regulatory scenario on circularity and the issue of the fragmentation that characterise these policies can be overcome.

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| **Table 3**Research agenda to improve the European policies on circular economy  |
| **Circular economy element** | **Research gaps**  |
| Design | Delineate a clear definition and taxonomy on circular economy.Define the features of a set of standards aimed at stimulating companies towards the adoption of design for circularity.Identify the improvements to the Ecodesign directive to make it more effective in promoting the creation of products designed for circularity.Investigate on how to further develop the EPR scheme to encourage firms in creating products that are designed for life extension practices.  |
| Reduce | Define how to improve the current set of regulations for hazardous waste management.Investigate if a single policy for hazardous and non-hazardous waste management can be more effective than a set of policies. |
| Reuse | Define policy instruments capable of promoting the adoption of reused resources.Investigate on the measures that can make virgin resources less competitive than the circular ones.Identify the legislative instruments to stimulate entrepreneurship on this field.  |
| Repair | Investigate on the strategies to stimulate repair by, for instance, making spare parts more accessible, promoting cooperation among stakeholders and by changing consumption behavior.Define the legislative measures to encourage entrepreneurship on repairing. |
| Remanufacturing | Identify the policy measures that can support producers in performing remanufacturing.Establish strategies to create an effective take-back system.Investigate on the policy instruments to stimulate entrepreneurship on this field. |
| Recycling | Investigate on the policy actions needed to develop a better collection, sorting and resource recovery system. Define the improvements to the recycling targets to make them more effecting in promoting this practice.Identify the legislative instruments that can reduce the reliance on virgin raw materials. Perform studies to identify the product categories for which it is better to adopt recycling than other circular practices. |
| Stakeholders’ cooperation | Identify strategies to further involve stakeholders in the policy making process.Investigate on the legislative measures that can stimulate a better cooperation among stakeholders. |
| Life Cycle Thinking | Define how to make companies disclose data about their products and services to perform LCA studies.Investigate on how to further adopt LCT in the policymaking process. |
| Data sharing | Define the data that need and can be shared by companies, and an adequate IT system for information disclosure.Establish a transparent and reliable monitoring system to calculate and improve the circular performances of firms. |
| Consumption behavior | Investigate on the policy measures that can promote a behavioural shift of both firms and customers towards more circular and sustainable consumption. |
| Market-based instruments | Identify the market-based instruments that can stimulate a wider adoption of circular practices, reduce the reliance on virgin raw materials and stimulate circular entrepreneurship. |

The research agenda was created with the contribution from the literature. However, the author believes that there are additional topics that require further investigation.

Scholars should better define how to concretely improve the policies of circularity. Most of the analyzed publication provide quite broad suggestions on how to further develop the rules on CE, while only few publications provide solid recommendations to enhance their effectiveness. More research providing concrete information on the manners to improve the various policies should be developed.

In addition, the analyzed studies provide a little focus on social issues. Several scholars claim that circular economy often neglects these aspects and that, consequently, policies are not capable of targeting them appropriately (Dagilienė et al., 2021; Maitre-Ekern, 2021). However, social issues need to be considered to realize a circular system that is fully sustainable (Milios, 2018). For this reason, it is essential for researchers and policymakers to put more emphasis on these matters.

The author also advocates for more research on circular entrepreneurship. It is of central importance to promote the emergence of entrepreneurial activities aimed at favoring practices such take-back, life extension and resource recovery in order to create a proper circular ecosystem. Nevertheless, the circular entrepreneurship field is still widely unexplored and more investigation is needed to adequately stimulate the creation of sustainable and circular ventures (Suchek et al., 2022).

Moreover, the author suggests performing research on the PPR concept proposed by Maitre-Ekern (2021). This policy instrument can be subject to further analysis because of its potential of making manufacturers design products not only for recycling, but also for life extension and duration before putting them on the market. This scheme can therefore be beneficial in stimulating design improvements for circularity and the creation of a fully functioning network of actors and, consequently, an efficient circular system.

Furthermore, it is essential to make the various stakeholder communicate in an adequate manner to create a solid network of actors capable of stimulating the transition towards CE. The Digital Product Passport can potentially be an effective tool to disclose the information related to products’ composition and lifecycle stages and, consequently, ease the cooperation efforts. This tool has already been adopted in the battery market and can be extended to other industries to support the information sharing process (Walden et al., 2021). However, as suggested by Walden et al. (2021), it is of central importance to plan the introduction of the DPP in an adequate manner. It is crucial to involve experts and stakeholders of the various industries to clearly define the data needs. In this manner, it is possible to avoid making the system burdensome for the actors who will use it, delineate a clear system of metrics and measurements, and protect the intellectual property. This careful planning stage allows creating an effective and efficient data sharing system that permits the creation a solid network of stakeholders, monitor their circular activities, and perform LCA studies in an effective way. For this reason, to ease the implementation of circular practices, it can be valuable to explore the potential benefits that a wider adoption of the DPP can provide.

Finally, the analyzed studies deliver suggestions that are providing incremental rather than radical changes in the policy scenario. If circular economy has the potential of driving our society towards sustainable development and if a drastic shift is needed to achieve this objective, then also the current policy scenario may need to undergo a radical change. The legislative measures that are currently in place are not capable of stimulating firms in embracing circular economy. Thus, it may be valuable to consider how a more drastic change, planned in a strategic manner, can drive our society towards the adoption of circularity and an ecological transformation.

## . Limitations and audience of the study

The study presents some limitations. The first is related to the fact that the author may have been biased when selecting the publications. The eligibility criteria and the relevance scale were created and applied maintaining the highest level of rationality and neutrality possible, but some bias may have still influenced the development of these criteria and the papers selection process. Secondly, the literature on circularity provides a more detailed description of the various aspects of CE and more features may have been included to enhance the granularity of the analysis. A more high-level perspective was adopted to assess how the general characteristics of this concept were addressed by experts in the field. Thirdly, including only publications in English may have prevented identifying additional studies. Ultimately, this study focuses on the impact that policies have on business practices and not on other relevant stakeholders such as consumers or public organizations.

Despite these limitations and opportunities for improvement, this paper can still be beneficial to scholars in this field. Indeed, it presents an updated picture on European CE policies and can provide valuable suggestions on how to improve the current set of laws to drive companies towards circular economy and realise an ecological transformation.

#  Conclusion

Circular economy can potentially contribute driving our society towards sustainable development and promoting an ecological transition. Government intervention and a good set of policies are considered as the most effective manners to support businesses in adopting this concept. However, the European policies on circularity are not cohesive and, consequently, they are uncapable on supporting firms in the transition towards CE. Likewise, the literature on how to improve the EU legislative scenario on circular economy is fragmented. Hence, there is little clarity on what the most effective policies are, and there is no consensus on which the best practices to promote the implementation of circularity are.

A systematic literature review was performed to assess which are the legislative measures that are relevant to drive companies towards CE and define what is consensual and not among the scientific community regarding the suggestions it provides to improve the European policies on circular economy. This methodological approach allowed grasping the matters on which scholars agree on, that can be considered as opportunities for improvement, and the ones characterised by a disagreement, which can be labelled as prospects for further research. Furthermore, a research agenda is provided to encourage researchers in improving the effectiveness of these policies. In this manner, more clarity and coherence among EU laws on circularity is provided and the problem of the fragmentation that characterise these policies can be overcome.

The analysis shows that scholar agree on the fact that policymakers should focus on creating a common definition and taxonomy on circular economy. This can support the various stakeholders involved in circular activities to clearly understand what their roles and duties are and, consequently, make them work towards the same objectives. Furthermore, they believe that a better set of standards, and enhancements in the Ecodesign directive and in the EPR scheme can stimulate a wider adoption of design for circularity. However, there is still not consensus on how to achieve this objective and further investigation is needed to define effective strategies and improvements.

Academics also believe that regulators should put in place an adequate set of incentives and disincentives to stimulate companies in adopting more reusing, remanufacturing and repairing practices and to encourage entrepreneurship in these fields. They also agree that legislators need to establish regulations to make virgin resources less attractive than the post-consumers ones to further stimulate the creation of a circular system. Moreover, policies need to encourage a change in the consumption behaviour of both firms and consumers to promote a more sustainable and circular use of resources. Nevertheless, the scientific community has not found a consensus on how to perform these developments yet.

Another aspect that scholars consider as important to drive the transition towards circularity and to enhance the reliance on secondary material is setting more stringent recycling targets and improving the collection, sorting and resources recovery technologies. They also claim that policies on hazardous waste management should be improved to safeguard human health and ecosystems. More research is needed to assess if a unique set of rules to regulate both non- and hazardous waste can overcome this challenge.

Experts in the field also agree that a better monitoring system should also be put in place to assess how companies are performing in relation to circularity and to constantly improve their practices. However, they still have not reached a consensus on the set of indicators and on the data collection system needed to perform the monitoring activities.

In addition, they argue it is fundamental to apply LCT in the policymaking process to assess what circular practices are best for each industry and delineate the most sustainable manners to manage the lifecycle of the various products categories. Nevertheless, there is not an agreement on how to gather the information needed to perform these studies. Thus, further investigation is needed on the data disclosure issue.

Furthermore, scholars agree that the relevant stakeholders should be more intensively involved in the policymaking process to collect their suggestions for improvement and define the best compromises that can allow supporting a prompt and effective transition from linearity to circularity. Indeed, academics claim that without the creation of a solid network of actors it is impossible to set up an efficient circular system. Still, there is currently a debate on how to make stakeholders communicate and cooperate in an adequate manner and more research is needed in this direction.

Experts also explain that realizing the aforementioned improvements requires sharing an adequate amount of data among the relevant stakeholders. But there is no consensus on how to establish this fundamental information disclosure and communication system.

Furthermore, more research should be performed in relation to circular entrepreneurship because, even if it has the potential of supporting the creation of a circular system, it is a widely unexplored field. The social impacts of CE should also be further analysed because they are essential to create a fully sustainable circular economy. Then, the concept of PPR and the DPP tool require additional investigation because of their potential high value in promoting the adoption of CE. It is also important to consider how radical rather than incremental changes in the policies on CE can provide a better transition towards circularity and sustainable development.

Therefore, regulators should focus on defining policies that can bring improvements on these aspects of circular economy otherwise there is the risk of jeopardizing the achievement of an ecological transition. Scholars have the possibility of supporting legislators in this process by focusing on the research gaps presented in this paper. Further investigation on these aspects can boost the adoption of CE among firms and turning them into a driver of the ecological transformation needed to make our society overcome the current economic, social and environmental challenges.

# Appendix A

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| **Table A.1**Classification of the papers according to the building elements of circular economy  |
| **Circular economy element** | **Number of papers**  | **Publications** |
| Design | 20 | Alaranta & Turunen, 2021Baran, 2019 Dalhammar, 2015Dalhammar, 2016de Römph & Cramer, 2020Flynn & Hacking, 2019Hartley et al., 2020Kunz et al., 2018Maitre-Ekern, 2021Mathieux et al., 2020Milios, 2018Milios, 2020Polverini, 2021Purnell et al., 2019Stumpf et al., 2021Talens Peiró et al., 2017Talens Peiró et al., 2020Tecchio et al., 2017van den Bergh, 2020Whicher et al., 2018  |
| Reduce | 5 | Alaranta & Turunen, 2021Bodar et al., 2018de Römph & Cramer, 2020de Römph & Van Calster, 2018Domenech & Bahn-Walkowiak, 2019 |
| Reuse | 4 | Ranta et al., 2018de Römph & Cramer, 2020Milios, 2021van den Bergh, 2020 |
| Repair | 4 | Kirchherr et al., 2018Maitre-Ekern & Dalhammar, 2019Milios, 2018Svensson-Hoglund et al., 2021 |
| Remanufacturing/Refurbishing | 4 | Milios, 2018Singhal et al., 2020Yuan et al., 2020Yang et al., 2016 |
| Recycling | 9 | Baran, 2019Beccarello & Di Foggia, 2018de Römph & Cramer, 2020Hartley et al., 2020Kirchherr et al., 2018Milios, 2018Purnell et al., 2019Ranta et al., 2018Talens Peiró et al., 2017 |
| Stakeholders’ cooperation | 19 | Bodar et al., 2018Braz & Marotti de Mello, 2022Dagilienė et al., 2021Dalhammar, 2016Ekins et al., 2019Fitch-Roy et al., 2020Flynn & Hacking, 2019Hartley et al., 2020Luo & Leipold, 2022Mathieux et al., 2020Milligan & O’Keeffe, 2019Purnell et al., 2019Schanes et al., 2019Talens Peiró et al., 2017Talens Peiró et al., 2020Whicher et al., 2018Wiesmeth, 2021Wilts & O’Brien, 2019Wysokińska, 2020 |
| Life Cycle Thinking | 10 | Alaranta & Turunen, 2021Bodar et al., 2018Dalhammar, 2015de Römph & Cramer, 2020de Römph & Van Calster, 2018Hartley et al., 2020Maitre-Ekern & Dalhammar, 2019Purnell et al., 2019Syberg et al., 2021Wilts & O’Brien, 2019 |
| Data sharing | 9 | Dalhammar, 2016de Römph & Cramer, 2020Hartley et al., 2020Milios, 2021Milligan & O’Keeffe, 2019Purnell et al., 2019Svensson-Hoglund et al., 2021Talens Peiró et al., 2020Walden et al., 2021 |
| Consumption behavior | 6 | Domenech & Bahn-Walkowiak, 2019Hartley et al., 2020Kirchherr et al., 2018Maitre-Ekern & Dalhammar, 2019van den Bergh, 2020Wiesmeth, 2021 |
| Market-based instruments | 5 | Baran, 2019Hartley et al., 2020Kirchherr et al., 2018van den Bergh, 2020Volk et al., 2019 |

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