Financing Circular Economy Projects: A Clinical Study[1]

JOÃO PINTO[a]; PAULO ALVES[a]; CLÁUDIO CASTENDO[b]

[a]Universidade Católica Portuguesa, Católica Porto Business School and CEGE, Portugal; [b]Banco Montepio and Universidade Católica Portuguesa, Católica Porto Business School, Portugal

To cite this article: Pinto, João, Paulo Alves & Cláudio Castendo. 2022. Financing Circular Economy Projects: A Clinical Study. European Review of Business Economics 73-100. DOI: https://doi.org/10.26619/ERBE-2022.2.1.4

ABSTRACT

This paper interconnects the literature on circular economy and sustainable finance. In addition to describing the reasons behind circular economy projects, this paper surveys the literature on financing circularity. The financial industry plays a significant and increasing role in promoting sustainability by supporting sustainable investment projects. To obtain funds for circular economy projects, sponsors face additional challenges due to business and financial complexities inherent to such projects. We characterise and describe firms' reasons for developing circular economy projects as well as how these projects are funded by using a clinical study focused on three projects. Extant literature presents 3Rs (Reduce, Reuse and Recycle); the reduction of cost and pollution; improvement in competitiveness, innovation, and processes; improvement of ESG ratings, and enhance reputation. All these reasons are positively correlated and address resource scarcity, impact on environment, and economic concerns. Innovative circular projects are typically funded via a mix of sustainable equity – venture capital funds, impact investors, EU funds – and debt – sustainable bonds (green and ESG bonds) and loans.

Keywords: financing instruments; circular economy; ESG; clinical study
JEL Codes: G11; G23; O13; Q56

CLIMATE CHANGE is shaping social and business landscapes with significant impacts on our society. More specifically, temperatures are rising and water shortages are becoming more frequent, resulting in food supplies becoming scarcer, and the gap between rich and poor widening (WBCSD Education, 2016). Businesses face major problems due to commodity price fluctuations and market instability as raw materials become more difficult or expensive to obtain. The linear economy, which was effective in generating material wealth for industrialised nations up until the 20th century, is showing flaws in the new

[1] The authors would like to thank Mário Coutinho dos Santos and two anonymous referees for their useful comments and suggestions. All errors and omissions remain the responsibility of the authors. The authors did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors, for this research. João is the corresponding author and can be reached at jpinto@ucp.pt.

millennium, and a near-term collapse is predicted (Sariatli, 2017). According to the Ellen MacArthur Foundation (2013), the current economic model, as shown in Figure 1, has its roots in the historically unequal distribution of income by geographic region. Industrialised nations have had an excess of material and energy resources mostly because resource consumers have been concentrated in the most developed regions, and material inputs have been sourced progressively from the global arena. These materials were inexpensive in this arrangement when compared to the expense of human labour. As a result, producers have been encouraged to establish business models that make great use of resources while minimising human labour (Ellen MacArthur Foundation, 2013).

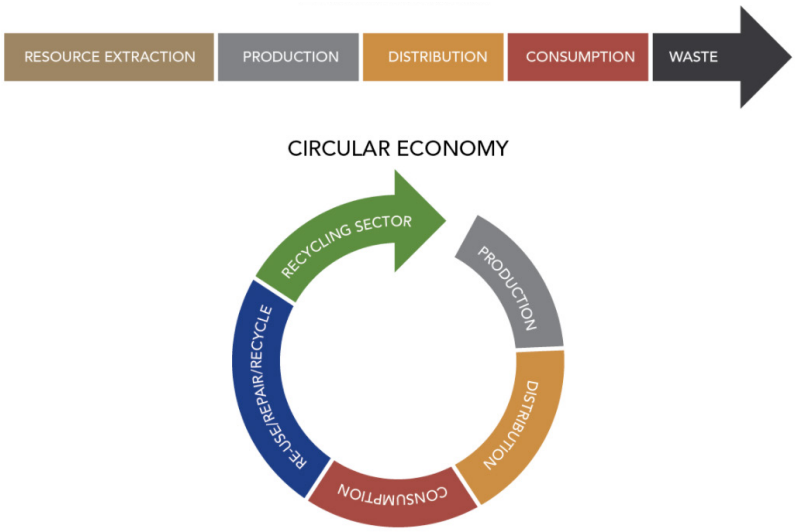
The inevitable result of low-cost materials and high-cost labour is a widespread disregard for recycling, reusing, and placing a high value on waste. According to the Ellen MacArthur Foundation (2013), regulatory, accounting, and fiscal rules have been supportive of this system. The lack of protocols for charging negative externalities means that producers have less incentive to examine the external costs of their operations.

Figure 1
Resource flow in a linear economy

Source: Export Leadership Forum (2015)

However, governments, investors, businesses, and civil society are increasingly interested in sustainability and the circular economy. To the benefit of present and future generations, sustainability envisions a balanced integration of economic performance, social inclusion, and environmental resilience (Geissdoerfer et al., 2017). To respond to the imminent risks and possibilities provided by these challenges, businesses must adapt and innovate. Under this framework, the circular economy emerged as an umbrella concept in the 2010s (Blomsma and Brennan, 2017), advocating for a more resource-effective and efficient economic system by restricting, slowing, closing materials and energy flows (Bocken et al., 2016; Ellen MacArthur Foundation, 2015). As pointed out by the Ellen MacArthur Foundation (2015a), the circular economy approach has the potential to generate significant economic, social, and environmental benefits. The more an industrial organisation reuses and recycles its waste, the closer it gets to the circular economy model, becoming more profitable (Lancaster, 2002) and environmentally friendly. Figure 2 exhibits the resource movement in a circular economy framework.

Figure 2
Resource flow in a circular economy



Source: Bortolotti (2015)

According to ING Bank (2015), firms are looking for opportunities within the circular economy or partnering with other firms that have moved towards this movement to increase their market value. Financing these projects is challenging. New technology and business models are frequently untested and sophisticated, relying on unstable supply chains, and operating in volatile markets (Goovaerts et al., 2018). Furthermore, circular economy projects frequently involve small sub-investment grade promoters who have little collateral or physical assets to provide to financiers. Therefore, sponsors frequently experience limited access to funding or higher costs of capital due to the increased market and credit risks involved (Goovaerts et al., 2018). According to EIB (2015), there is a danger of a sluggish transition and significant opportunity costs on access-to-finance conditions for circular economy initiatives. As a result, policy intervention and support in the form of innovative funding and financing instruments are critical.

Under this framework, this study emerges as a clinical study, by examining three relevant case studies, with the purpose of identifying the instruments and methods for financing circular economy projects and, ultimately, thereasons and the advantages that lead to the development of these projects.

The remainder of the paper is organised as follows. Section 2 reviews extant empirical literature. Research questions, methodology and the importance of clinical studies are presented in Section 3. Section 4 provides the data regarding the three case studies, more specifically: description, financing instruments, development, potential, patents, and implementation. The reasons behind the

implementation of the three selected circular economy projects are presented in Section 5, while Section 6 concludes this study.

I. Literature Review

A. From a linear to a circular economy

Natural resources on planet earth are limited. The rate at which we use these has long been noted as unsustainable (Malthus, 1798; Green, 1894; Meadows et al., 1972; Behrens et al., 2007). At the same time, a growing world population requires an increase in the production of goods and services. To achieve sustainability, society needs to dramatically reduce its use of natural resources (Commoner, 1972; Myers and Kent, 2003; Cumming and Cramon-Taubadel, 2018). As society moves towards strategies of sustainable development, debates have emerged on how resources can be used more efficiently (Daly, 1990).

A stream of literature focuses on how to achieve a circular economy (Pearce and Turner, 1990). Based on the work of Leontief (1991), the underpinning idea is to repeatedly use the same resources in a loop, decoupling precious stocks of virgin resources from economic activity. In this approach to sustainability, the key driver is that more sustainable living at the societal level can only occur when organisations use resources more efficiently (Figge et al., 2018). According to the United Nations Environment Programme (2012), in the circular economy, nutrients and material resources circulate and remain within biospheres and product systems. In addition, a wide variety of metrics has emerged aiming at capturing the extent of firms' contributions to a more circular economy. Common to most indicators is the assumption that the efficiency of a resource can be measured by the number of times it is used, i.e., its circularity (Figge et al., 2018). Contrarily, Franklin-Johnson et al. (2016) propose a different approach and emphasise the length of time a resource is in use, i.e., its longevity. Based on empirical evidence, the Ellen MacArthur Foundation (2013), Murray et al. (2015), and Wijkman and Skanberg (2015) point out that the circular economy fits into three spheres of sustainable development, as it is a system that replenishes resources needed for manufacturing, while promising opportunities for economic development. In turn, it will improve the quality of life.

According to Murray et al. (2015), the main features that make the circular economy stand out in the achievement of sustainability goals are the closed material loops and the design of products with the possibility of reusing them. In 1987, the Brundtland Commission[2] called for the creation of new ways to assess progress towards sustainable development, resulting in the emergence of a wide variety of sustainable development indicators advanced by academics,

2 It is also known as the UN Special Commission on the Environment at the United Nations. The purpose of this Commission was to help nations to achieve the goal of sustainable development (Kono, 2014).

companies, environmental agencies, and governmental organisations (Hardi & Zdan, 1997; Michalos, 2014). Currently, the implementation of circular economy practices appears as a timely, relevant, and practical option to meet the Sustainable Development Goals (SDGs). In fact, as Hicks et al. (2005) and Schroeder et al. (2019) show, the implementation of circular economy approaches can be applied as a "toolbox" for achieving Sustainable Development targets.

The circular economy paradigm is extensively explored by institutions as a potential path to increase the sustainability of our economic system (Elia et al., 2017). Su et al. (2013) argue that the circular economy is based on the 3R principles, namely reducing, reusing, and recycling. Reducing refers to decreasing consumption of resources and generation of pollutants (Su et al., 2013). Reusing means utilising resources as many times as possible or in diverse ways (Brunori et al., 2005), and recycling is the process of turning end-of-life products into renewable energy or resources, allowing them to enter a new product life cycle (Hicks et al., 2005).

There is a general agreement that the objective of circular economy projects is to reduce harm to the environment and to close the loop of the product lifecycle (Ellen MacArthur Foundation, 2013; EU Commission, 2014; Prieto-Sandoval et al., 2018). In addition, Scheel (2016) argues that it will also deliver valuable products to others from redesigned waste, and that aims to create a new relationship with goods and materials, a relationship that saves resources, energy and creates local jobs (Stahel, 2016). Corporates and financial institutions actively search for their role in the circular economy not only because it is a growing market, but as it is also stimulated by technological innovation, increasing resource productivity (Manyika et al., 2013; Ellen MacArthur Foundation, 2012). Additionally, it addresses the sustainability targets of many banks, as they recognise opportunities directly linked to clients who are leading in sustainability, as they are typically more innovative, have better financial performance and credit rating (ING, 2015). Moreover, investors are more aware of linear risks and circular opportunities, as the current linear model exposes companies and prevents investors from achieving sustainable value creation. These companies are under pressure from global trends such as resource scarcity, environmental uncertainty, tightening regulations, and disruptive new businesses and technologies.

As a result, investment in these companies is very exposed to linear risks (Circle Economy, 2017). As Ueda (2019) mentions, there are large business opportunities in the circular economy, and funding those activities should be attractive to the financial sector. On the one hand, the finance industry, as Schomaker (2019) refers, has a crucial role to play in promoting sustainability and is already showing significant leadership. On the other hand, and according to the European Commission (2019), both companies and the financial sector see each other as responsible for failing to fulfil their responsibilities on sustainable and regenerative matters. In addition, prices and accounting rules that create adverse incentives need to be addressed. Furthermore, tools and procedures that help investors and lenders evaluate risks associated with linear and circular business practices are required and should be improved (Schomaker, 2019).

B. The circular economy and sustainable finance

The anticipated shortages of virgin materials are one of the major challenges to the economy. Pearce and Turner (1989) first proposed the concept of the circular economy in 1989. They argue that a traditional open-ended economy was created without a built-in desire to recycle, as seen by the environment being treated as a waste reservoir. However, it was the Ellen MacArthur Foundation (2012) that brought the circular economy to the attention of the public. While this was primarily a scientific argument for decades, the foundation elevated the issue to the level of politicians and business leaders by making it a vital economic concern and tying it to company executives. The transition to a circular economy requires a significant shift in how we generate and consume goods (European Commission, 2019). As pointed out by Planing (2015), transitioning from a linear to a circular economy requires four constituents, namely: (i) materials and product design, (ii) business models, (iii) global reverse networks, and (iv) enabling conditions.

Business models, economic systems, policymakers and regulators, and financial institutions are the main actors of this transition to a more circular economy (European Commission, 2019). This transition is inevitable, as the world population increases in a context of limited natural resources. This will imply new business and employment opportunities. However, considerable barriers exist to a widespread adoption of more circular practices, including economic incentives, accounting rules, and regulation that often favour conventional linear solutions and business models (EU Commission and Ministry of Environment of Japan, 2019). According to Rhode (2017), transitioning towards a greener and more resilient economy requires massive public and private investment. Under this framework, finance has to facilitate the shift to a circular economy, more specifically, by providing resources for circular investments, insurance products suitable for circular practices, such as leasing and sharing, and developing rating systems and information disclosure requirements that help improve transparency around sustainability-related business risks (EU Commission and Ministry of Environment of Japan, 2019).

Sustainable finance has carried out significant work on how to assess and communicate risks related to climate change (Soppe, 2004; Haigh, 2012; Schoenmaker and Schramade, 2019; Coleton et al., 2020). Consequently, the industry has developed knowledge and scenario analysis tools, gained experience in working with natural science data, and this will facilitate the understanding of how to address sustainability issues in a holistic manner. There are strong linkages between climate change mitigation and the circular economy, which can help to stimulate investments in circularity. As pointed out by the EU Commission and the Ministry of Environment of Japan (2019), "the transition to a circular economy requires the contribution of all groups in society". In the future, sustainable investments must evolve from a niche to a mass market that integrates sustainability into business models and culture, with an eye towards 2030 and beyond. To do so, the market must address greenwashing, SDG washing concerns and its geographic imbalance. The transition must be sped up with effective

coordination and monitoring of their activities (United Nations Conference on Trade and Development, 2021).

C. Financing circularity

A successful transition to a circular economy requires specialised policies and investment (Wijkman and Skånberg, 2015). Until recently, contributions from banking and other financial institutions towards the push for sustainability have never been valued (Alfredsson and Wijkman, 2014) in comparison to supply chain management concerns in sustainable manufacturing. The European Commission (2019) argues that a significant increase in demand for funding to support circular economy businesses and products will be required to make an effective transition. The volume of "circular finance" is insufficient to sustain a shift in how material value is captured and preserved.

Companies with circular economy business models and products need to be able to obtain funds to scale up their operations to shift value chains. Since the transition must be a systematic shift, access to funding must be provided across all industries (European Commission, 2019). According to Rizos et al. (2015), small and medium-sized enterprises (SMEs) face difficulties in obtaining financing as financial institutions frequently consider SMEs as having higher risk. In addition, even if SMEs are successful in convincing a bank to lend them money, obtaining the collateral/guarantees required by the bank may also be challenging (Acheampong, 2016).

Companies can obtain funds from both external and internal sources of financing (Brealey et al., 2001; Zimmerer et al., 2002; Mikócziová, 2010). Zimmerer et al., (2002) indicate that understanding and selecting the right form of finance for a company is crucial to its success. Information asymmetry is particularly severe in new firms and developing businesses (Mikócziová, 2010). As mentioned by the European Investment Bank Report (2015), the existing financial instruments offered by public and commercial actors can present significant possibilities for entrepreneurs who want to invest in setting-up or altering their operations towards circular principles. Table 1 provides an overview of the financing instruments that can be used to fund circular business models (ING, 2015). The first column lists the various financing players, while the second and third columns describe the products they provide and how they can be utilised to finance circular projects. To obtain the target combination of both internal and external funding, a combination of financing instruments is frequently required. Despite all these financing possibilities, one of the major barriers to the adoption of circular projects is the lack of finance available on acceptable terms (Goovaerts and Verbeek, 2018). These types of companies or projects are more complex, resulting in higher risks than typical investment deals. Therefore, innovative circular projects are externally funded via venture capital funds, impact investors, EU funds (Goovaerts and Verbeek, 2018), sustainable loans and bonds. The latter can be ESG (sustainability and social impact bonds) and green bonds (Tang and Zhang, 2020; Flammer, 2021).

Table 1
Supply and demand for financing circular business models

Bank Finance	Corporate Debt	Traditional corporate financing with corporate guarantees to finance circular companies.
	Lease	Can be used in pay-per-use business strategies. Creditworthy clientele and products with predictable residual values in second hand marketplaces are eligible.
	Factoring and Supply Chain Finance	Can overcome the pre-financing problem associated with pay-per-use revenue models by selling uncertain future cash flows to a financial institution.
	Project Finance	Large stand-alone circular projects may be eligible for funding via non or limited recourse debt.
	Balance sheet reduction through off-balance-sheet financing	The issue of other off-balance-sheet special purpose entities can be addressed.
Capital Markets	Equity Finance (e.g., IPO)	Valuable sources of financing for predominantly larger and more established circular companies that fulfil the capital market's requirements and specifications.
	Debt Finance: Green Bonds	
Impact Investors		Most circular firms are still in the early stages of development, are not profitable, or lack a track record. As they have a longer-term vision, more 'patient' investors, and a risk/return that is less linked, non-commercial finance can bridge the gap from pilot to growth stage.
Venture Capital, Private Equity, Family Offices		Many start-up companies in the circular economy rely on this form of funding. Their requirement for rapid growth and payback periods, on the other hand, may limit their suitability for circular businesses.
Near Banks like Google, Apple, Amazon, etc.		Provide additional payment options and perhaps working capital solutions.
Crowdfunding	Peer2Peer Lending	Source of funding for circular companies that involve the (local) community or are founded on crowd-pleasing ideas.
	Equity Investment	

Source: Adapted from ING (2015)

II. Research Questions and Methodology

A. Research questions

This study aims to contribute to the research avenue on the financing of circular economy projects, essentially by trying to fulfil the gaps regarding the methods and instruments used to finance these projects. This contribution is based on a

clinical study methodology, which will be focused on three clinical case studies (Jensen et al., 1989).

As discussed in the literature review, there are a variety of reasons that, individually or collectively, motivate firms and institutions to implement and finance circular investment projects. Analysing each of the case studies, in terms of their characteristics, objectives, potential impact, sustainable and economic financial terms, allows for a better understanding of the factors that lead to the development of circular economy projects and determine which financing methods are employed to achieve this goal. Based on extant theoretical and empirical literature, we raised the following research questions:

1. What are the main reasons underlying the development of projects in a circular economy?
2. What are the financing instruments used to enable the implementation of such projects, from start-up to market launch?

Ultimately, this research will contribute to the discussion on the drivers/reasons, methods and instruments used to finance circular projects, which allows the transition from a linear to a circular economy to be fostered.

B. A clinical study approach

We use a qualitative approach as the main method to study how finance supports circular projects. A qualitative case study approach is a research methodology focused on the exploration of a phenomenon within some particular context through various data sources, and it undertakes the exploration through a variety of lenses in order to reveal multiple facets of that phenomenon (Baxter and Jack, 2008). The lack of research on how projects belonging to the circular economy are financed and the challenges they face supports our analysis. We use an exploratory examination and inductive approach, aiming to identify the reasons behind the implementation of three relevant projects – the case studies – in a circular economy, and how these projects are (or will be) financed.

In corporate finance, clinical studies were discussed initially by Jensen et al. (1989) in the editorial of the Journal of Financial Economics, as well as their role in the development of financial economics. The first set of papers in the new Clinical Papers section appeared in the same issue of the Journal of Financial Economics with the goal of offering a high-quality forum for academic research into particular cases, events, practices, and specific applications. Clinical studies stand as an essential method of study as they provide insights into the world, challenge accepted theories, and use distinctive sources of data. These papers, like some of the medical literature from which the term "clinical" is derived, will frequently deal with single cases or a small number of cases of particular interest. Jensen et al. (1989) expected "new high-quality empirical and theoretical research to emerge as a result of these clinical studies." This result can help theorists and empiricists arrive at empirically relevant imperfect market

theories by providing an in-depth examination of a phenomenon's key aspects (Kenton, 2020).

The roles and operations of financial institutions are changing dramatically as new products and practices emerge on a regular basis. As these changes imply new problems of theoretical interest, new strategies to communicate these fascinating changes to the scientific community are necessary. Clinical papers, which are mostly based on real-life occurrences, can help in the discovery and communication process, as well as in the advancement of financial science. As pointed out by Jensen et al., (1989), "clinical studies, as a result, assist in the planning of both theoretical and empirical research". These papers typically focus on descriptive and normative subjects rather than quantitative ones. The announcement of the "Corporate Governance Clinical Paper Competition", developed by the European Corporate Governance Institute in collaboration with the Journal of Financial Economics, the Swedish Center for Business and Policy Studies, and the Jan Wallander and Tom Hedelius Research Foundation,[3] is another argument in favor of the intention to develop this type of research methodology. Its main goal was to promote the development of clinical studies on cases of corporate governance in Europe that would allow researchers to better understand the complexities of companies and their behaviour, something that is often impossible to achieve using "traditional" methods (formal models and econometric analyses/statistics). Clinical studies such as those by McConnell and Schwartz (1992), Esty (1999), Rommens et al. (2003) and Mills (2005) examine concrete examples in relation to a specific theoretical question. Despite this, certain clinical studies look at a group of cases and use analyses that are more similar to those used in empirical studies. Bortolotti et al. (2001), Buysschaert et al. (2004) and Dissanaike and Papazian (2005) are some examples of this type of research methodology.

III. Financing Circular Economy Projects

According to the European Commission (2019), the existing financing instruments from public and private lenders open a world of possibilities for entrepreneurs who want to start a circular firm. While large businesses can generally fund the circular shift internally through internal cash flows, young and fast-growing businesses are sometimes dependent on external capital to grow. Today's taxation is mostly based on labour income, penalising labour as a "renewable factor input" above material and non-renewable inputs. The Ellen MacArthur Foundation (2012) argues that shifting the tax burden away from labour and income and onto non-renewable resources is crucial. Individual companies

3 Jan Wallander and Tom Hedelius Research Foundation was designed to aid social scientific research, particularly in the fields of economic history, economic geography, business economics, economics, and econometrics (University of Boras, 2022).

and groups of companies will require not only assistance with ownership transitions, but also funds for research and development and new technologies.

The financial sector plays an essential role in the circular economy, both in a transition and a steady state. Circular businesses or projects are inherently more complex, resulting in more risks than traditional investment deals. Thus, as in Uzsoki (2020), to solve the world's multiple sustainability concerns, new financial instruments are required. On the one hand, they are critical for investments that would otherwise have a poor risk-reward profile, but are expected to have a significant ESG impact. On the other hand, as sustainable investing becomes more popular, it is essential that participants in the financial markets have a variety of investment options. We analyse three important circular projects in terms of their characterisation, objectives, financing instruments used, patents, and institutions involved.

A. The Extraction of Bromelain from Pineapple

This first project consists of a method for extracting an enzyme denominated bromelain (BR) from pineapple waste to use in new products for people and animals. This enzyme can be found in vegetable tissues such as the peel, stem, fruit, and leaves of the Bromeliaceous family, including the pineapple stem. In addition, this enzyme is used in a variety of industries, including food and pharmaceuticals. In the food industry, BR is utilised as a meat tenderising enzyme, but it is also employed in brewing and as a functional protein in pre-digestion and digestive aids. It is important to emphasise that only natural substances are used in the technology (biological precipitants). Funds for this project were obtained from a PhD Scholarship, financed by the "*Fundação para a Ciência e Tecnologia*" (FCT). In the following table, the instruments, financing, and institution data is provided:

Table 2
Financing and Funds – The Extraction of Bromelain from Pineapple

Technology	Financing Instrument and Funds		Institution(s)
Bromelain	PhD Scholarship	67,800 € – 100%	Catholic University of Portugal – Faculty of Biotechnology (UCP-FB)

This project is currently at a laboratory prototype stage and a spin-off[4] has been created to commercialise the technology or to install equipment for the execution of the technology. In terms of the patents, the bromelain patent has already been granted at European level by the European Patent Office (EPO),[5]

4 Separation of a company's businesses through the formation of one or more distinct companies (Ostling et al., 2016)

5 Reviews European patent applications, allowing inventors, researchers, and companies from all over the world to obtain protection for their inventions in up to 44 countries via a centralised and uniform process (European Patent Office, 2021).

and in some countries in Asia. There is the expectation that between 2023 and 2025, the technology will be implemented. The development of the project, namely its scaling-up, is dependent on the entry of a venture capital fund into the new company to be created via project finance and the ability to attract bank financing. Finally, the submission of an application for European funds may be crucial to its development.

B. The Extraction of Keratin from Pig's Hair

This project consists of a more simplistic method of extracting keratin from pig's hair by utilising a commercial detergent for digestion followed by ultrafiltration, making this a simple, low-cost, and ecologically friendly process. Pig farming is a huge global industry that produces several by-products that pollute the environment. Pig hair is an example of a by-product from slaughterhouses. Pig dehairing uses a lot of water and produces wastewater with a lot of organic matter, fat, and dirt. As a result, hair is a waste product that should be managed to maximise its re-use and value. Hair is now utilised in a variety of products, including brushes, felt, rugs, upholstery, plaster binding, insulation, and glue. Keratin, which is found in wool, feathers, and other keratinous substances and makes up around 80% of hair, is one of the most important components. The extraction of keratin from human hair has been described in several pieces of research. However, limited research has been carried out on extracting keratin from pig hair. Nonetheless, existing approaches are related to several issues, including pollution, high costs, and time consumption. This project was completely financed by funds from COMPETE2020.[6] Table 3 provides the financing instrument, funds, and institutions responsible for the development and implementation of this technology.

Table 3
Financing and Funds – Keratin from Pig's Hair

Technology	Financing Instrument and Funds		Institution(s)
Keratin	Funds from COMPETE2020	33,000 € – 100%	UCP-FB, Riopele, CENTI, CITEVE

This Project is one step ahead, as the process was scaled up using 15 kg of raw material (pig hair residues). This process was carried out in two phases. The first phase took place at the Faculty of Biotechnology (CBQF), where the fat from the pig's hair was removed with Mistolin. The second phase took place at the Polytechnic Institute of Coimbra, at the Agrarian School, where the keratin was separated from the rest. The patent has not been granted yet. Despite this, the technology is being evaluated by the EPO. Contact with an Italian company that uses keratin as a fundamental input in its production process has been made, with the aim of acquiring further knowledge. By 2023 the technology will be licensed and then commercialised.

6. Developed in line with the main national and European strategic guidelines, the Competitiveness, and Internationalization Operational Programme (COMPETE 2020) mobilises the European Structural and Investment Funds for the period 2014-20 within the scope of the thematic objectives and investment priorities domain of Portugal 2020 (COMPETE 2020, 2015).

C. Extraction of Peptides from Algae and Microalgae

This project consists of an optimised method to extract a greater amount of protein content and high nutrient digestibility to be used as a food ingredient and/or feed farmed fish and shellfish species, in comparison with the existing approaches. This leads to the creation of higher-value seafood products as well as more sustainable and efficient food chains. Microalgae, often known as seaweed, are unicellular organisms that exist individually, in chains, or in groups. They can be produced without wasting vital resources like freshwater or arable land, and all they require is sunlight for energy. Working with microalgae also has the advantage of rapid growth, since they can double in size in, approximately, less than a day. Microalgae contain proteins that have promising properties in a variety of fields, including cosmetics, food supplements, and health, and can be found in commercial products. Microalgae proteins boost dietary benefits and can also be used as a food preservative in food supplements. Finally, significant research has been carried out so far, particularly in cosmetics and food goods, but bioactive peptides found in these algae can still introduce additional benefits. Therefore, recent research is focusing on the antioxidant, anti-inflammatory, anti-hypertensive, and anti-diabetic properties of bioactive microalgae to discover and create even more benefits. The first phase of this project was financed by funds from COMPETE2020 and the Center of Biotechnology and Fine Chemistry of the Catholic University of Portugal (CBQF). More specifically, 75% of the funds were financed by COMPETE2020, and the remaining 25% by CBQF. The following table provides the financing, funds and the institutions related to this project.

Table 4
Financing and Funds – Peptides from Algae and Microalgae

Technology	Financing Instrument and Funds		Institution(s)
Algae and Microalgae	Funds from COMPETE 2020	35,000 € – 75%	UCP-FB, SONAE MC and other(s)

This project is at a laboratory prototype stage and the patent has been granted. The process of obtaining funding for the scaling-up of the project has already begun. It will be implemented via project finance, with project sponsors providing equity, together with a venture capital fund, and about 70% of the funding will be obtained via bank syndicated loans.

D. Development and Implementation

These projects are innovative, disruptive and have the potential to reach the industrialisation stage and, subsequently, be commercialised. To reach industrial and commercial levels, the following stages will require more financial funds, and this needs to be assessed and measured by institutions. To gather these funds, a variety of more complex financial instruments should be used, as

well as the presence and participation of key players. Another relevant aspect of these projects is the markets that they will reach if they fulfil their potential. All of them will be implemented in the cosmetic sector. However, individually, the extraction of bromelain from pineapple and pineapple peels and steams will reach the pharmaceutical and nutraceuticals fields. The keratin project will be present in the biomedical and chemical aquaculture fields, and the algae technology will reach the chemical aquaculture and the food industry. To have a clear picture of the dimension of these relevant sectors, Table 5 provides data of the market size. All industries are already quite relevant in terms of their global economic impact. This is seen by the market size of the industries, with the food and pharmaceutical industries showing higher market sizes.

Table 5
Market size of the different fields

Industries / Fields / Markets	Market Size (in USD $ Millions) – 2020
Aquaculture	202,960
Cosmetic	277,670
Food	7,706,412
Medical	456,900
Nutraceuticals	413,000
Pharmaceutical	1,265,200

Source: Data collected from Grand View Research

IV. The Reasons behind Circular Economy Projects

In an effort to address resource scarcity, impact on the environment, and economic concerns, governments, companies, and societies worldwide are actively promoting the circular economy concept. Under this framework, this chapter discusses the main advantages regarding the development of circular economy projects. Appendix A shows the correspondence between extant theoretical and empirical literature and the reasons behind circular economy projects.

A. 3Rs – Reduce, Reuse and Recycle

The imperatives of reducing, reusing, recycling, and recovering, which are widely accepted as pillars of the circular economy, are used to extend the useful lifetime of materials (Kirchherr et al., 2017). In other words, materials and resources must be used for as long as possible in the economy, extending their lifespan and reducing waste. Recycling is one method of reusing goods

and thereby reducing primary resource extraction. This concept has prompted research on the drivers and constraints to waste generation (reduce and reuse implications) and/or recycling (Soukiazis and Proença, 2020; Valenzuela-Levi, 2019).

The circular economy is defined by the 3Rs: reduce, reuse, and recycle (Preston, 2012; Lieder and Rashid, 2015; Murray et al., 2015; Jawahir and Bradley, 2016). According to McDonough and Braungart (2010), during the 1920s, the basic notion of reducing was using fewer resources to produce the same amount of output. However, in the 1980s, within eco-efficiency circles, reducing also meant limiting pollution, emissions, and waste. Manufacturers had historically been held responsible for reducing emissions and resource usage (Stahel, 1982). In the past, products were considered as reused when they were donated to charity organisations as gifts to the less fortunate in society. Today, consumers purchase at second-hand stores to contribute to a more sustainable world (Morgan and Mitchell, 2015).

Recycling is the process of converting materials and products that have been discarded as garbage into new items (Jawahir and Bradley, 2016). In addition, as Morgan and Mitchell (2015) point out, closed-loop recycling (manufacturing new products from waste without changing the original content of the material used) and open-loop recycling (manufacturing new products from waste without changing the original composition of the material used) are two types of recycling (manufacturing new products which are lower in quality because the materials lose their original composition). Open-loop recycling is a fairly common practice. It raises concerns because products are not developed to be easily reused or recycled, and recycling items costs so much money and energy due to their material composition (McDonough and Braungart, 2010; Ellen MacArthur Foundation, 2013). When the products being recycled are valuable and there are procedures in place for their simple collection and reprocessing, recycling is economically profitable (Narayan, 2001).

Improving the recovery and recycling of critical raw materials[7] could provide major benefits to the EU, such as reducing reliance on third-country imports (European Parliament, 2011). In addition, the use of recycled materials may alter demand patterns for primary materials, resulting in less primary material extraction. According to WBCSD Education (2016), companies could apply the 3Rs principle to waste streams and extract value from them. All material streams could be perceived as vital resources that should be implemented to their highest potential. With this approach, the company's waste value chain could be converted into a positive spiral of value. The 3Rs are completely embedded in the clinical studies previously analysed.

7 Critical raw materials are those with high economic value and a high risk of supply scarcity (European Comission, 2014).

B. Reduction of Pollution

The circular economy model strives to achieve production and consumption sustainability by using closed cycles (closed loops) for regeneration and restoration, as well as a combination of maintenance, repair, reuse, renovation, remanufacturing, and recycling activities (Bocken et al., 2014; Hazen et al., 2017; Perey et al., 2018). This occurs due to more efficient resource use and reuse, as well as reduced overall resource inputs, energy, emissions, and waste leakage, which could reduce negative environmental consequences without sacrificing growth and prosperity, all while improving the economy, environment, and the balance in society(Kiefer et al., 2019; Geissdoerfer et al., 2018; Manninen et al., 2018). Geissdoerfer et al. (2017) refer that closing material loops in industrial ecosystems helps ensure that resources are used continuously. Long-term design, proactive maintenance, recycling, repairing, refurbishment, and remanufacturing can all contribute. As a result, the circular economy model is an economic system of resource recycling and reuse in which element reduction is critical; that is, decreasing output to a minimal level and opting for reutilisation of elements that cannot be returned to the environment due to their properties (Geissdoerfer et al., 2017).

As previously stated, the goal of this type of closed-loop cyclic system is to eliminate waste by converting end-of-life goods into resources for new ones (Stahel 2016). The fundamental redesign of materials, products, and value creation processes should dramatically reduce the negative environmental effects of emissions and resource waste that naturally accompany the use of physical goods by optimising the efficient use of resources (Cheng and Shiu, 2012; Rosa et al., 2019). Several pieces of research on the environmental impacts of the circular economy or resource efficiency are available in the literature. One example of that research was developed by Cambridge Econometrics & BIO Intelligence Service (2014), in which they examine the impact of resource productivity targets at the EU level. According to the study, increasing the EU's resource productivity by 3% would result in a 25% reduction in GHG emissions by 2030. Another study carried out by Lawton et al. (2013) estimates the environmental benefits of material savings in the food and beverage, manufacturing, fabricated metal products, hospitality and food services sectors for the European Commission. According to the study, boosting resource efficiency in the studied sectors can result in a 2-4 percent reduction in total yearly GHG emissions in the EU. The Ellen MacArthur Foundation (2015b) has also conducted an analysis of environmental benefits for Denmark. According to the study, Denmark's carbon footprint can be reduced by 3-7[8] percent by implementing a circular economy strategy. Furthermore, by 2035, the study predicted a 5–50 percent reduction in virgin resource consumption. Again, the reduction of pollution is also achieved with the three cases discussed previously.

8 This reduction is determined by the "change in worldwide carbon emissions divided by 'business as usual' Denmark carbon emissions" (Ellen MacArthur Foundation, 2015, p. 26).

C.Improvement in Competitiveness, Innovation and Processes

Circular economy principles frequently require new visions and strategies, as well as a fundamental redesign of product conceptions, service offerings, and channels to achieve long-term solutions (Lewandowski, 2016). This aligns with a re-evaluation of suppliers and partners, as well as value chains that prioritise long-term efficiency above short-term efficiency (Geissdoerfer et al., 2018). Improvement of companies' competitiveness, innovation and their processes are dependent on their dynamic capabilities. More specifically, the companies' ability to change their own capabilities, for instance by developing additional products, in response to changes in the external environment (Zahra et al., 2006). Dynamic capabilities include not only capabilities but also the processes and routines of businesses (Barreto, 2010). This implies that the creation and development of circular economy skills constitute an example of the development of the dynamic capabilities of organisations (Aragon-Correa and Sharma, 2003; Bag et al., 2019; Khan et al., 2020; Russo, 2009; Amui et al., 2017; Scarpellini, 2020). Circular economy and environmental management require the integration of a variety of resources and competencies, such as information systems, technological systems, and tacit knowledge. Furthermore, increasing consumer pressure for environmental responsibility has driven companies to improve their responsiveness, flexibility, and ability to change rapidly. Finally, duties that characterise the circular economy and environmental management include path dependencies and continuous improvement (Russo, 2009; Scarpellini, 2020; Zhu et al., 2013).

Higher rates of technology development, improved materials, labour, energy efficiency, and more profit opportunities for firms are all advantages of a more innovative economy (Ellen MacArthur Foundation, 2013). Proactive environmental initiatives, such as the development of circular economy models, are dynamic capabilities linked to product and process focused practices (Aragon-Correa and Sharma, 2003). Product-focused practices refer to the development of circular economy compliant products (Zucchella and Previtali, 2019; Reike et al., 2018; Bocken et al., 2016; Katz-Gerro and Lopez Sintas, 2019; Lewandowski, 2016).

Circularity can be achieved through product life extension practices, which involve a greater focus on the design phase of the product life cycle (Bocken et al., 2016). This means that products and components are created with the purpose of long-term durability and life spans in mind. As the Ellen MacArthur Foundation (2012) refers, beyond the implications of circularity on specific sectors, any gain in material productivity is expected to have a significant positive impact on economic development. Circularity has proven to be a promising new frame capable of stimulating creative solutions and increasing innovation rates, as shown in the three clinical studies presented in chapter III.

D. Improvement of the ESG Ratings

Long discussions have erupted over how ESG factors influence a business's economic and financial performance, and ultimately its market value. Investing in

socially responsible aspects, according to the traditional neoclassical concept, incurs additional costs for companies (Palmer et al., 1995), and is often regarded as a negative factor for economic performance, as the firm's competitiveness may be harmed (Baumol and Blackman, 1991). Using ESG criteria in investment decision-making has become increasingly significant, particularly for high-profile institutional investors (Cornell et al., 2020). According to Fish et al. (2019), global sustainable assets under management were around $30 trillion in 2019. In recent years, societal expectations have shifted to the point where a company that solely aims to maximise shareholder value or concentrates on short-term profits risks losing touch with its consumers and stakeholders over time. Companies must now recognise and address their responsibilities to the world and its resources through the lens of business risk. Transparency, accountability, and sustainability of corporate processes are being improved all around the world (World Travel and Tourism Council, 2017). According to the Ellen MacArthur Foundation (2020), the circular economy helps to address many other environmental challenges, including biodiversity loss, societal depletion, natural resource scarcity, pollution, water contamination, and waste, in addition to addressing both the causes and impacts of climate change. Using a circular economy lens can also help achieve goals relating to social and governance issues, such as local job creation, upskilling opportunities, addressing economic injustice and value allocation, and supply chain transparency. Many researchers have highlighted and recorded the impact of governance on a company's market value, with research findings indicating that there is a positive causal link between good corporate governance and a company's market value (Brown and Caylor, 2006; Bebchuk and Cohen, 2005; Gompers et al., 2003). According to Bassen and Kovacs (2008), ESG indicators are crucial in obtaining additional information about a company's performance that is not included in accounting data. They define ESG as non-financial information regarding a company's performance and challenges related to ESG issues, which provides additional relevant data and allows investors to make more informed investment decisions by allowing them to better identify risks and opportunities. Finally, by implementing circular economy projects, firms improve resource allocation, shareholder relationships, governance and, eventually, increase a firm's market value. The clinical studies previously presented have a high positive impact potential in general in terms of ESG, and in particular at the environmental level.

E. Improvement of the Reputation of Institutions

On the corporate side, there has been a growing awareness of the need to be socially responsible, or at least appear to be socially responsible, either to fend off pressure from interest groups and the media, or to promote themselves to customers (Cornell et al., 2020). Several studies have found a link between environmental, social, and governance factors and non-financial performance predictors such as corporate reputation and brand equity (Hsu, 2012; Cahan, S. et al., 2015). According to the Ellen MacArthur Foundation (2012), companies may build life-long service relationships with their customers instead of one-time

transactions. In addition, companies must adjust, as consumers of durable goods have evolved into users. Maintaining smooth operations to provide maintenance, product upgrades, and other product-related services, as well as persuading consumers to return products at the end of each usage cycle, will require new, long-term client connections.

F. Reduction of Costs

All the previous referred advantages of the development and implementation of circular economy projects are levered when the technology developed allows the reduction of production costs for companies, and subsequently, lower prices for the intermediate and final consumer. As mentioned before, in contrast to the traditional linear model, a circular economy approach is an economic system whose major purpose is to make the best and most sustainable use of resources by increasing efficiency and thereby minimising waste. It aims to create value by maximising resource efficiency and drastically altering production and consumption methods (Kirchherr et al., 2017).

Most of the circular economy literature focuses on the benefits of production (Rizos et al., 2017; Ghisellini et al., 2016). Manufacturers can save money by remanufacturing their products, and the environment benefits as well because less resources are required (Pigosso et al., 2010). The recycling of critical raw materials, once a secondary raw-material market is operational, may improve supply security for businesses and lower production costs (European Parliament, 2011). According to the Ellen MacArthur Foundation (2013), companies and consumers are expected to share the net benefits of a more circular economy.

However, the clinical studies in this paper show that the true customer benefits extend beyond the price effect. Improved utility and a lower total cost of ownership are also advantages. In addition, WBCSD Education (2016) refer that circular economy projects and business models can reduce costs of production and, in certain cases, provide entirely new profit streams, improve supply chain resilience, and reduce exposure to resource shortages and price volatility. Rentals or leasing contracts, for example, are new business models that build longer-term engagement with customers. There are also some intangible advantages, such as a better reputation and lower risks. Last but not least, financial subsidies and incentives are frequently provided with circular economy initiatives, which can help to strengthen their business case (WBCSD Education, 2016).

V. Conclusion

The circular economy is a growing market, where companies and institutions are actively searching for their role. On one hand, this occurs due to the large business opportunities and the reputation of institutions. Nonetheless, on other hand, there is a consensus that regulation and policy will become stricter, which will demand a gradual change in the production, methods and the inputs and outputs of companies. The development and implementation of circular economy

projects have become a relevant concern, and in some companies and certain institutions, are already a priority. This study emerges to fulfil the lack of relevant research regarding the impact that finance has on circular economy projects. Bearing this in mind, a qualitative approach is used, more specifically, an exploratory examination and inductive approach. Clinical studies, according to Jensen et al. (1989), help establish the agenda, both in terms of developing theoretical trials and empirical studies. In this regard, we consider the implementation of an empirical study on this topic as an important window of opportunity, based on the underlying reasons behind circular economy projects and financing instruments, as identified by the clinical study performed in this dissertation. The reasons that lead to the development of circular economy projects, which are supported by several authors, determine the financing instruments and funds employed in the projects. The reasons are the following:

1. 3Rs – Reduce, Reuse and Recycle;
2. Reduction of Pollution;
3. Improvement in Competitiveness, Innovation and Processes;
4. Improvement of the ESG Ratings;
5. Improvement of the Reputation of Institutions;
6. Reduction of Costs.

All these reasons are positively correlated and address resource scarcity, impact on the environment, economic concerns, governments, companies, and societies worldwide. Currently, every project is at an early stage of development, more specifically, the Bromelain and the Algae and Microalgae projects are both at a laboratory prototype stage, and the Keratin project is one step ahead, and the technology was scaled up using 15 kg of raw material (pig hair residues). These projects are innovative, disruptive and have the potential to reach the industrialisation stage and, subsequently, be commercialised. Bearing this in mind, all the funds to finance the Bromelain project were obtained from a PhD Scholarship, financed by FCT. Thus, both the keratin from pig's hair and peptides from algae and microalgae were obtained from COMPETE 2020 and supported by renowned institutions. In order to fulfil their potential and reach industrial and commercial levels, the following stages will require more financial funds, and this needs to be assessed and measured by institutions. To gather these funds, a variety of more complex financial instruments, as suggested in Table 2, should be considered, as well as the presence and participation of key players. In terms of the patents, the bromelain patent has already been granted at European level by the European Patent Office (EPO), in some countries in Asia, and currently, it is expected that between 2023 and 2025, the technology will be implemented. Contrarily, the keratin and the algae patents have not yet been granted. Despite this, the keratin technology is being assessed by the EPO, and there is also contact with an Italian company, and if the partnership is successful, by 2023 the technology will be licensed and then commercialised. Taking all of this into account, due to the empirical analysis carried out and the potential of each of

the three projects, this study allows us to assess that the circular economy, the instruments and the reasons underlying its financing are crucial for the success of institutions and society. This implies that the circular economy will have to be developed further, so that in the long-term, there are fewer and fewer obstacles and, consequently, the financing of circular economy projects is seen as a vital aspect for institutions, thus allowing them to gain even more notoriety, in comparison with their competitors.

REFERENCES

Acheampong, J. (2016). Green Financing: Financing Circular Economy Companies. Case Studies of Ragn-Sellsföretagen AB and Inrego AB. Master of Science Thesis.

Alfredsson, E., & Wijkman, A. (2014). The Green, Inclusive Economy: Shaping society to serve sustainability – minor adjustments or a paradigm shift? Prestudy for Mistra, Key Issues for a Green Economy.

Amui, L. B., Jabbour, C. J., Jabbour, A., & Kannan, D. (2017). Sustainability as a dynamic organizational capability: a systematic review and a future agenda toward a sustainable transition. Journal of Cleaner Production, 142(1), 308-322.

Aragon-Correa, J. A., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. Academy of Management Review, 28(1), 71-88.

Bag, S., Gupta, S., & Foropon, C. (2019). Examining the role of dynamic remanufacturing capability on supply chain resilience in circular economy. Management Decision, 57(4), 863-885.

Bakken, R. (2021, August 9). What Is Sustainable Finance and Why Is It Important? Retrieved March 6, 2022, from Harvard Extension School: https://extension.harvard.edu/blog/what-is-sustainable-finance-and-why-is-it-important/

Banton, C. (2020). Mass Production. Retrieved February 11, 2022, from Investopedia: https://www.investopedia.com/terms/m/mass-production.asp

Barreto, I. (2010). Dynamic capabilities: a review of past research and an agenda for the future. Journal of Management, 256-280.

Bassen, A., & Kovacs, A. M. (2008). Environmental, social and governance key performance indicators from a capital market perspective. Zeitschrift für Wirtschafts- und Unternehmensethik, 9(2), 182-192.

Baumol, W. J., & Blackman, S. A. (1991). Perfect markets and easy virtue: Business ethics and the invisible hand. USA: B. Blackwell.

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. The Qualitative Report, 13, 544-559.

Bebchuk, L. A., & Cohen, A. (2005). The costs of entrenched boards. Journal of Financial Economics, 78(2), 409-433.

Behrens, A., Giljum, S., Kovanda, J., & Niza, S. (2007). The material basis of the global economy: Worldwide patterns of natural resource extraction and their implications for sustainable resource use policies. Ecological Economics, 64(2), 444-453.

Blomsma, F., & Brennan, G. (2017). The emergence of Circular Economy: A New Framing Around Prolonging Resource Productivity. Journal of Industrial Ecology, 21(3), 603-614.

Bocken, N. M., Pauw, I. d., Bakker, C., & Grinten, B. v. (2016). Product design and business model strategies for a circular economy. Journal of Industrial and Production Engineering, 33(5).

Bocken, N. M., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. Journal of Clean Production, 65, 42-56.

Bortolotti, B., D` Souza, J., Fantini, M., & Megginson, W. (2001). Sources of Performance Improvement in privatised Firms: A Clinical Study of the Global telecommunications Industry. SSRN Electronic Paper Collection.

Bortolotti, L. (2015). Circular economy, an act of courage to rethink the system. Retrieved March 15, 2022, from http://www.italiachecambia.org/2015/11/economia-circolare-coraggio-ripensare-sistema/

Brealey, R. A., Myers, S. C., & Marcus, A. J. (2001). Fundamentals of Corporate Finance, 3rd ed. McGraw-Hill Irwin Education: Boston, MA.
Brown, L., & Caylor, M. (2006). Corporate governance and firm valuation. Journal of Accounting and Public Policy, 25(4), 409-434.
Brunori, C., Cremisini, C., Massanisso, P., Pinto, V., & Torricelli, L. (2005). Reuse of a treated red mud bauxite waste: studies on environmental compatibility. Journal of Hazardous Materials, 117(1), 55-63.
Burton, I. (1987). Our common future: The world commission on environment and development. Environment, 29(5), 25-29.
Butterworth, J. (2014). CEC Mentors Program. Retrieved March 28, 2022, from Circular Economy Club: https://www.circulareconomyclub.com/cec-mentors-program/mentoring-competition-jamie-butterworth/
Buysschaert, A., Deloof, M., & Jegers, M. (2004). Equity sales in Belgian corporate groups: expropriation of minority shareholders? A clinical study. Journal of Corporate Finance, 10, 81-103.
Cahan, S. F., Chen, C., Chen, L., & Nguyen, N. H. (2015). Corporate social responsibility and media coverage. Journal of Banking & Finance, 59, 409-422.
Cambridge Econometrics and BIO Intelligence Service. (2014). Study on modelling of the economic and environmental impacts of raw material consumption. Final Report prepared for the European Commission.
Capital.com. (2022, March). External Financing. Retrieved March 5, 2022, from Capital.com: https://capital.com/external-financing-definition
Cheng, C. C., & Shiu, E. C. (2012). Validation of a proposed instrument for measuring eco-innovation: an implementation perspective. Technovation, 32(6), 329-344.
Circle Economy. (2017). The circular economy for investors. Circle Economy.
Coleton, A., Brucart, M., Gutierrez, P, Le Tennier, F & Moor, C. (2020). Sustainable Finance, European Bank Authority, EBA staff paper series N.º 6.
Commoner, B. (1972). The Environmental Cost of Economic Growth (Vol. 3). (R. G. Ridker, Ed.) Washington DC, United States of America: Population. Resources and the Environment.
COMPETE 2020. (2015). About us. Retrieved from COMPETE 2020: https://www.compete2020.gov.pt/sobre-nos
Cornell, B., & Damodaran, A. (2020). Valuing ESG: Doing Good or Sounding Good?
Cumming, G. S., & Cramon-Taubadel, S. v. (2018). Linking economic growth pathways and environmental sustainability by understanding development as alternate social–ecological regimes. (S. A. Levin, Ed.) Proceedings of the National Academy of Sciences of the United States of America, 115(38), 9533-9538.
Daly, H. E. (1990). Toward some operational principles of sustainable development. Ecological Economics, 2(1), 1-6.
Dissanaike, G., & Papazian, A. (2005). Management Turnover in Stock Market Winners and Losers: A Clinical Investigation. ECGI (61).
ECGI. (2022). About ECGI. Retrieved February 11, 2022, from ECGI: https://ecgi.global/content/about-ecgi
Elia, V., Gnoni, M. G., & Tornese, F. (2017). Measuring circular economy strategies through index methods: A critical analysis. Journal of Cleaner Production, 142(4), 2741-2751.
Ellen MacArthur Foundation. (2012). Towards the circular economy – Economic and business rational for an accelerated transition (Vol. 1). Isle of Wight, United Kingdom. Retrieved 2021, from Ellen MacArthur Foundation: https://emf.thirdlight.com/link/x8ay372a3r11-k6775n/@/preview/1?o
Ellen MacArthur Foundation. (2013). Towards the Circular Economy – Opportunities for the Consumer Goods Sector. Ellen Macarthur Foundation.
Ellen MacArthur Foundation. (2015a). Growth Within: A Circular Economy Vision for a competitive Europe. Ellen MacArthur Foundation.
Ellen MacArthur Foundation. (2015b). Potential for Denmark as a Circular Economy. A Case Study From: Delivering the Circular Economy. Retrieved from https://tinyurl.com/zv8exrl
Ellen MacArthur Foundation. (2015c). Towards a Circular Economy: business rationale for an accelerated transition. Retrieved March 2022, from https://ellenmacarthurfoundation.org/towards-a-circular-economy-business-rationale-for-an-accelerated-transition

Ellen MacArthur Foundation. (2020). Financing the Circular Economy: Capturing the opportunity. Ellen MacArthur Foundation.
Esty, B. (1999). A Case Study of the Effective Use of Project Finance. Journal of Applied Corporate Finance, 12(3), 26-42.
EU Commission, & Ministry of Environment of Japan. (2019). Report on Sustainable Finance for a Circular Economy – G20 Resource Efficiency Dialogue 2019. Japan/EU Joint Workshop, Tokyo.
EU Commission. (2014). Towards a Circular Economy: a Zero Waste Programme for Europe. Brussels.
European Commission. (2014). Communication on the review of the list of critical raw materials for the EU and the implementation of the Raw Materials Initiative. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM, 297.
European Commission. (2019). Accelerating the transition to the Circular Economy – Improving access to finance for circular economy projects. European Commission.
European Investment Bank. (2015). Assessment of access-to-finance conditions for projects supporting Circular Economy. European Investment Bank.
European Parliament. (2011). Report on an effective raw materials strategy for Europe.
European Patent Office. (2021, August 12). The EPO at a glance. Retrieved from European Patent Office: https://www.epo.org/about-us/at-a-glance.html
Export Leadership Forum. (2015). Circular Economy: From Waste to Wealth. Retrieved March 15, 2022, from http://blog.exportleadership.com/2015/11/04/the-circular-economy-from-waste-to-wealth/
Figge, F., Thorpe, A. S., Givry, P., Canning, L., & Franklin-Johnson, E. (2018). Longevity and Circularity as Indicators of Eco-Efficient Resource Use in the Circular Economy. Ecological Economics, 297-306.
Fish, A., Kim, D. H., & Venkatraman, S. (2019). The ESG sacrifice.
Flammer, C. (2021). Corporate Green Bonds, Journal of Financial Economics, 142, 499-516.
Folger, J. (2021, January 18). What is an NGO (Non-Governmental Organization)? Retrieved February 11, 2022, from Investopedia: https://www.investopedia.com/ask/answers/13/what-is-non-government-organization.asp
Franklin-Johnson, E., Figge, F., & Canning, L. (2016). Resource duration as a managerial indicator for Circular Economy performance. Journal of Cleaner Production, 133, 589-598.
Fundação para a Ciência e a Tecnologia. (2022). Funding. Retrieved March 14, 2022, from FCT – Fundação para a Ciência e a Tecnologia: https://www.fct.pt/apoios/index.phtml.en
Geissdoerfer, M., Morioka, S. N., de Carvalho, M. M., & Evans, S. (2018). Business Models and supply chains for the circular economy. Journal of Cleaner Production, 190, 712-721.
Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The circular economy – a new sustainability paradigm? Journal of Cleaner Production, 143, 757-768.
Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. Journal of Cleaner Production, 114, 11-32.
Gompers, P., Ishii, J., & Metrick, A. (2003). Corporate governance and equity prices. The Quarterly Journal of Economics, 118(1), 107-156.
Goovaerts, L., Schempp, C., Busato, L., Smits, A., Zutelija, L., & Piechocki, R. (2018). Financing Innovation and Circular Economy. European Investment Bank.
Goovaerts, L., & Verbeek, A. (2018). Sustainable Banking: Finance in the Circular Economy. Investing in Resource Efficiency.
Green, D. I. (1894, January 1). Pain-Cost and Opportunity-Cost. The Quarterly Journal Of Economics, 8(2), 218-229.
Haigh, M. (2012). Publishing and defining sustainable finance and investment, Journal of Sustainable Finance & Investment, 0(0), 1-7.
Hardi, P., & Zdan, T. (1997). Principles and practice. Assessing Sustainable Development. International Institute for Sustainability.
Hazen, B. T., Mollenkopf, D. A., & Wang, Y. (2017). Remanufacturing for the circular economy: an examination of consumer switching behaviour. Business Strategy and the Environment, 26, 451-464.

Hicks, C., Dietmar, R., & Eugster, M. (2005, July). The recycling and disposal of electrical and electronic waste in China–legislative and market responses. Environmental Impact Assessment Review, 25(5), 459-471.

Hsu, K. (2012). The advertising effects of corporate social responsibility on corporate reputation and brand equity: Evidence from the life insurance industry in Taiwan. Journal of Business Ethics, 109(2), 189-201.

ING. (2015). Rethinking finance in a circular economy. Financial implications of circular business models. ING Economics Department.

Jawahir, I. S., & Bradley, R. (2016). Technological Elements of Circular Economy and the Principles of 6R-Based Closed-loop Material Flow in Sustainable Manufacturing. Procedia CIRP, 40, 103-108.

Jensen, M. C., Fama, E. F., Jr., J. B., Ruback, R. S., Schwert, G. W., Jr., C. W., & Warner, J. (1989). Editorial: Clinical Papers and Their Role in the Development of Financial Economics. Journal of Financial Economics, 24, 3-6.

Journal of Financial Economics. (2022). Journal of Financial Economics. Retrieved February 11, 2022, from Journal of Financial Economics: https://www.jfinec.com

Katz-Gerro, T., & Lopez Sintas, J. (2019). Mapping circular economy activities in the European Union: Patterns of implementation and their correlates in small and medium-sized enterprises. Business Strategy and the Environment, 28(4), 485-496.

Kenton, W. (2020). Imperfect Market. Retrieved March 5, 2022, from Investopedia: https://www.investopedia.com/terms/i/imperfectmarket.asp

Khan, O., Daddi, T., & Iraldo, F. (2020). Microfoundations of dynamic capabilities: Insights from circular economy business cases. Business Strategy and the Environment, 29(3), 1479-1493.

Khemani, R. S., & Shapiro, D. M. (1993). Glossary of Industrial Organisation Economics and Competition Law. Directorate for Financial, Fiscal and Enterprise Affairs – OECD.

Kiefer, C., Del Rio, P., & Carrillo-Hermosilla, J. (2019). Drivers and barriers of eco-innovation types for sustainable transitions: a quantitative perspective. Business Strategy and the Environment, 28(1), 155-172.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: an analysis of 114 definitions. Resources, Conservation and Recycling, 127, 221-232.

Klassen, R. D., & McLaughlin, C. P. (1996). The impact of environmental management on firm performance. Management Science, 42(8), 1199-1214.

Kono, N. (2014). Brundtland Commission (World Commission on Environment and Development). Encyclopedia of Quality of Life and Well-Being Research.

Kotsantonis, S., & Serafeim, G. (2019). Four Things No One Will Tell You About ESG Data. (Spring, Ed.) Journal of Applied Corporate Finance, 31(2), 50-58.

Lancaster, M. (2002). Principles of sustainable and green chemistry. Handbook of green chemistry and technology.

Lawton, K., Carter, C., Lee, J., Tan, A., Trigo, A. d., Luscombe, D., & Briscoe, S. (2013). The opportunities to business of improving resource efficiency. AMEC Environment & Infrastructure and Bio Intelligence Service for the European Commission.

Leontief, W. (1991). The economy as a circular flow. Structural Change and Economic Dynamics, 2(1), 181-212.

Lewandowski, M. (2016). Designing the business models for circular economy – towards the conceptual framework. Sustainability, 8(43).

Lieder, M., & Rashid, A. (2015). Towards circular economy implementation: a comprehensive review in context of manufacturing industry. Journal of Cleaner Production.

Malthus, T. R. (1798). An Essay on the Principle of Population. Cambridge University Press.

Manninen, K., Koskela, S., Antikainen, R., Bocken, N., Dahlbo, H., & Aminoff, A. (2018). Do circular economy business models capture intended environmental value propositions? Journal of Cleaner Production, 171, 413-422.

Manyika, J., Chui, M., Bughin, J., Dobbs, R., Bisson, P., & Marrs, A. (2013). Disruptive technologies – Advances that will transform life, business, and the global economy. (Mckinsey Global Institute) Retrieved October 8, 2021, from McKinsey & Company: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/disruptive-technologies

McConnell, J., & Schwartz, E. (1992). The Origin of LYONs: A Case Study in Financial Innovation. Journal of Applied Corporate Finance, 4, 40-47.

McDonough, W., & Braungart, M. (2010). Cradle to cradle: Remaking the way we make things. MacMillan.

Meadows, D. H., Randers, J., & Meadows, D. L. (1972). The Limits to Growth. New York: Universe Books.

Michalos, A. C. (2014). Encyclopedia of quality of life and well-being research. Dordrecht, Netherlands: Springer.

Mikócziová, J. (2010). Sources of investment finance in firms in Slovakia. Journal of Competitiveness, 2(1).

Mills, R. (2005). Assessing Growth Estimates in IPO Valuations – A Case Study. Journal of Applied Corporate Finance, 17(1), 73-78.

Morgan, J., & Mitchell, P. (2015). Employment and the circular economy: Job creation in a more resource efficient Britain. Retrieved March 2022, from http://www.green- alliance.org.uk/resources/Employment%20and%20the%20circular%20economy.pdf

Murray, A., Skene, K., & Haynes, K. (2015). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. Journal of Business Ethics, 140, 1-12.

Myers, N., & Kent, J. (2003, April 15). New consumers: The influence of affluence on the environment. Proceedings of the National Academy of Sciences of the United States of America, 100(8), 4963-4968.

Narayan, R. (2001). Drivers for biodegradable/compostable plastics and role of composting in waste management and sustainable agriculture. Bioprocessing of Solid Waste and Sludge, 11(1).

OECD. (1997). Regulatory Reform: A Synthesis. p. 11.

Ostling, G., Wachtell, Lipton, Rosen, & Katz. (2016). 2016 Spin-Off Guide. Retrieved from Harvard Law School Forum on Corporate Governance: https://corpgov.law.harvard.edu/2016/03/26/2016-spin-off-guide/

Palmer, K., Oates, W., & Portey, P. R. (1995). Tightening environmental standards: the benefit-cost or the no-cost paradigm? Journal of Economic Perspectives, 9(4), 119-132.

Pearce, D. W., & Turner, R. K. (1989). Economics of Natural Resources and the Environment. Johns Hopkins University Press.

Pearce, D. W., & Turner, R. K. (1990). Economics of Natural Resources and the Environment. Baltimore: The Johns Hopkins University Press.

Perey, R., Benn, S., Agarwal, R., & Edwards, M. (2018). The place of waste: changing business value for the circular economy. Business Strategy and the Environment, 27(5), 631-642.

Pigosso, D. C., Zanette, E., Ometto, A. R., & Rozenfeld, H. (2010). Ecodesign methods focused on remanufacturing. Journal of Cleaner Production, 18(1), 21-31.

Planing, P. (2015). Business Model Innovation in a Circular Economy Reasons for Non- Acceptance of Circular Business Models. Open Journal Of Business Model Innovation.

Porter, M. (n.d.). Making Strategic Trade-offs. Retrieved February 23, 2022, from Harvard Business School: https://www.isc.hbs.edu/strategy/creating-a-successful-strategy/Pages/making-strategic-trade-offs.aspx

Preston, F. (2012). A Global Redesign? Shaping the Circular Economy. Energy, Environment and Resource Governance.

Prieto-Sandoval, V., Jaca, C., & Ormazabal, M. (2018). Towards a consensus on the circular economy. Journal of Cleaner Production, 179, 605-615.

Reike, D., Vermeulen, W. J., & Witjes, S. (2018, August). The circular economy: New or Refurbished as CE 3.0? – Exploring Controversies in the Conceptualization of the Circular Economy through a Focus on History and Resource Value Retention Options. Resources, Conservation and Recycling, 135, 246-264.

Rhode, C. (2017). An Economy Transitioning from Brown to Green. Ifo Institute – Leibniz Institute for Economic Research at the University of Munich, 15(3), 51-55.

Rizos, V., Behrens, A., Kafyeke, T., Hirschnitz-Garbers, M., & Ioannou, A. (2015). The Circular Economy: Barriers and Opportunities for SMEs. CEPS Working Documents.

Rizos, V., Tuokko, K., & Behrens, A. (2017). The Circular Economy: A Review of Definitions, Processes and Impacts. Centre for European Policy Studies, 1.

Rommens, A., Deloof, M., & Jegers, M. (2003). Why do Holding Companies Trade at a Discount? A Clinical Study. Belgian Financial Research Forum – Diepenbeek.

Rosa, P., Sassanelli, C., & Terzi, S. (2019). Towards circular business models: a systematic literature review on classification frameworks and archetypes. Journal of Cleaner Production, 236.

Russo, M. V. (2009). Explaining the impact of ISO 14001 on emission performance: a dynamic capabilities perspective on process and learning. Business Strategy and the Environment, 18(5), 307-319.
Sariatli, F. (2017). Linear Economy versus Circular Economy: A Comparative and Analyzer Study for Optimization of Economy for Sustainability. Visegrad Journal on Bioeconomy and Sustainable Development.
Scarpellini, S., Valero-Gil, J., Moneva, J., & Andreaus, M. (2020). Environmental management capabilities for a "circular eco-innovation". Business Strategy and the Environment.
Scheel, C. (2016). Beyond sustainability. Transforming industrial zero-valued residues into increasing economic returns. Journal of Cleaner Production, 131, 376-386.
Schoenmaker, D. & Schramade, W. (2019). Principles of Sustainable Finance, Oxford University Press.
Schomaker, A. (2019). Report on Sustainable Finance for a Circular Economy – Japan/EU Joint Workshop G20 Resource Efficiency Dialogue 2019. Tokyo.
Schroeder, P., Anggraeni, K., & Weber, U. (2019). The relevance of circular economy practices to the sustainable development goals. Journal of Industrial Ecology, 23(1), 77-95.
Schwarz, M. (2016). A Sustainist Lexicon. Architectura & Natura.
Soppe, A. (2004). Sustainable Corporate Finance. Journal of Business Ethics, 53: 213-224.
Soukiazis, E., & Proença, S. (2020). The determinants of waste generation and recycling performance across the Portuguese municipalities – a simultaneous equation approach. Waste Management, 114, 321-330.
Stahel, W. R. (1982). The product life factor. An Inquiry into the Nature of Sustainable Societies: The Role of the Private Sector. Series: 1982 Mitchell Prize Papers, NARC.
Stahel, W. R. (2016). The circular economy. Nature News (531), 435-438.
Su, B., Heshmati, A., Geng, Y., & Yu, X. (2013). A review of the circular economy in China: moving from rhetoric to implementation. Journal of Cleaner Production, 42, 215-227.
Swedish Center for Business and Policy Studies. (2022). About SNS. Retrieved February 23, 2022, from SNS: https://www.sns.se/en/about-sns/
Tang, D. & Zhang, Y. (2020). Do shareholders benefit from green bonds?, Journal of Financial Economics 61, 101427.
Ueda, Y. (2019). Report on Sustainable Finance for a Circular Economy – Japan/EU Joint Workshop G20 – Resource Efficiency Dialogue 2019. Tokyo.
United Nations. (2022). About Us. Retrieved February 11, 2022, from United Nations: https://www.un.org/en/about-us
United Nations Conference on Trade and Development. (2021). World Investment Report – 2021 – Investing in Sustainable Recovery. New York: United Nations.
United Nations Environment Programme. (2012). Global Environment Outlook 5: Environment for the future we want. United Nations Environment Programme.
United Nations System Staff College. (2017). The 2030 Agenda for Sustainable Development. United Nations System Staff College Knowledge Centre for Sustainable Development, 1-2.
University Of Boras. (2022). Handelsbankens forskningsstiftelser (Jan Wallander and Tom Hedelius foundation, Tore). Retrieved February 23, 2022, from HB: https://www.hb.se/en/research/research-portal/funders/handelsbankens-forskningsstiftelser-jan-wallander-and-tom-hedelius-foundation-tore-browalds-foundation/
Uzsoki, D. (2020). Sustainable Investing: Shaping the future of finance. International Institute for Sustainable Development.
Valenzuela-Levi, N. (2019). Factors influencing municipal recycling in the Global South: the case of Chile. Resources, Conservation and Recycling, 150.
WBCSD Education. (2016). Unlocking More Value with Fewer Resources – A practical guide to the Circular Economy. WBCSD Leadership Program.
Wijkman, A., & Skånberg, K. (2015). The Circular Economy and Benefits for Society. Jobs and Climate Clear Winners in an Economy Based on Renewable Energy and Resource Efficiency. A study pertaining to Finland, France, the Netherlands, Spain and Sweden. Club of Rome.
World Travel and Tourism Council. (2017). Understanding the critical issues for the future of travel and tourism, 2017. Retrieved from WTTC: www.wttc.org
Zahra, S. A., Sapienza, H. J., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: a review, model and research agenda. Journal of Management Studies, 43(4), 917-955.

Zhu, Q., Cordeiro, J., & Sarkis, J. (2013). Institutional pressures, dynamic capabilities and environmental management systems: Investigating the ISO 9000 – Environmental management system implementation linkage. Journal of Environmental Management, 114(15), 232-242.

Zimmerer, T., Scarborough, N. M., & Wilson, D. (2002). Essentials of entrepreneurship and small business management. Upper Saddle River, NJ: Prentice Hall, 1-3.

Zucchella, A., & Previtali, P. (2019). Circular business models for sustainable development: A "waste is food" restorative ecosystem. Business Strategy and the Environment, 28(2), 274-285.

Appendix A. Extant literature and reasons behind circular economy projects

	Reasons behind Circular Economy Projects					
	3Rs - Reduce, Reuse and Recycle	Reduction of Pollution	Improvement in Competitiveness, Innovation and Processes	Improvement of the ESG Ratings	Improvement of the Reputation of Institutions	Reduction of Production Costs
Authors, Studies and Reports	Stahel W.R. [1982]	Cheng and Shiu [2012]	Aragon-Correa and Sharma [2003]	Baumol and Blackman [1991]	Ellen MacArthur Foundation [2012]	Pigosso et al. [2010]
	Narayan [2001]	Lawton et al. [2013]	Russo [2009]	Palmer et al. [1995]	Hsu [2012]	European Parliament [2011]
	McDonough and Braungart [2010]	Bocken et al. [2014]	Barreto [2010]	Gompers et al. [2003]	Cahan et al. [2015]	Ellen MacArthur Foundation [2013]
	European Parliament [2011]	Cambridge Econometrics & BIO Intelligence Service [2014]	Ellen MacArthur Foundation [2012]	Bebchuk and Cohen [2005]	Cornell et al. [2020]	Ghisellini et al. [2016]
	Preston [2012]	Ellen MacArthur Foundation [2015]	Ellen MacArthur Foundation [2013]	Brown and Caylor [2006]		WBCSD Education [2016]
	Ellen MacArthur Foundation [2013]	Stahel W.R. [2016]	Zhu et al. [2013]	Bassen and Kovacs [2008]		Kirchherr et al. [2017]
	Murray et al. [2015]	Hazen et al. [2017]	Bocken et al. [2016]	World Travel and Tourism Council [2017]		Rizos et al. [2017]
	Morgan and Mitchell [2015]	Geissdoerfer et al. [2017]	Lewandowski [2016]	Fish et al. [2019]		
	Lieder and Rashid [2015]	Geissdoerfer et al. [2018]	Zahra et al. [2016]	Cornell et al. [2020]		
	Jawahir and Bradley [2016]	Manninen et al. [2018]	Amui et al. [2017]	Ellen MacArthur Foundation [2020]		
	WBCSD Education [2016]	Perey et al. [2018]	Geissdoerfer et al. [2018]			
	Kirchherr et al. [2017]	Kiefer et al. [2019]	Reike et al. [2018]			
	Valenzuela-Levi [2019]	Rosa et al. [2019]	Bag et al. [2019]			
	Soukiazis and Proença [2020]		Karl-Gerro and Lopez Sintas [2019]			
			Zuchella and Previtali [2019]			
			Khan et al. [2020]			
			Scarpellini [2020]			