

# The Implementation of the Circular Economy R-Principles and Strategies: The Portuguese Hotel Industry Perspective

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**Abstract:** Circular Economy (CE) is a concept that has been gaining increasing importance in business circles and advocated by European Union, and by several governments worldwide. It is acknowledged that it has the potential to optimise resource efficiency, minimise production and consumption of greenhouse gas emissions, while simultaneously granting competitive advantage business prospects. Although it has been gaining momentum among academia, politicians, and practitioners, it is apparent some struggling when it comes to the design of a framework explaining how companies can embrace circularity and on how to adapt their business model to this new economic system. Despite its importance and applicability by the travel and tourism sector in general and the hotel industry in particular, it is insufficiently studied and examined. This empirical study investigates this concept on the Portuguese hotel industry perspective concerning the adoption of CE practices and CE R-principles through a survey instrument disseminated across the Portuguese hotel industry, with 78 valid responses. This article also introduces a new set of R-principles to the already existing ones, and contributes to the scientific research on the travel and tourism industry, and mainly to the one linked with the Portuguese hotel industry, which has been vaguely examined up to now. The results obtained indicate that these R-principles have been gaining importance, being adopted, and put into practice by the Portuguese hotel industry with special emphasis on the 3R-Principles (Reduce, Reuse, Recycle) along with Repair. Findings also indicate that some initiatives that are in line with a Circular Economy paradigm, namely recycling, reducing water and energy consumption, and cleaning management policies, towel and bed linen programmes, staff and education programmes, green products, certifications, among others, are also being considered.

**Keywords:** Circular Economy, Portuguese Hotel Industry, R-Principles, Natural Resources

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## 1. Introduction

The travel and tourism industry, a significant provider to global economic growth, faced a drastic downturn due to the COVID-19 pandemic, resulting in substantial job losses and economic decline. The impact of COVID-19 highlighted the immense significance and positive role played by travel and tourism. In 2020, the sector witnessed a loss of 62 million jobs, resulting in a global employment figure of only 271 million. This substantial decline of 18.6% echoed throughout the entire industry, notably affecting small and medium-sized enterprises (SMEs) – constituting roughly 80% of all businesses in this sector – as well as women, youth, and minority groups. Simultaneously, the sector faced staggering losses amounting to nearly USD 4.9 trillion, leading to a drastic 50.4% year-on-year reduction in its global contribution to GDP. This decline starkly contrasted with the 3.3% drop experienced by the overall global economy during the same period (World Travel and Tourism Council [WTTC], 2022). Although 2021 marked the recovery for this sector, progress was slower than anticipated. This deceleration derived partly from the impact of rigid and irregular border controls, and the absence of coordinated efforts among governments in addressing the pandemic. Despite these challenges, the travel and tourism sector managed to increase its contribution to GDP by USD 1 trillion, signifying a notable increase of 21.7%, reaching a total of USD 5.8 trillion. Additionally, the industry recovered 18.2 million jobs, representing a 6.7% increase. In 2021, there was a slow recovery, but challenges persisted due to border controls and governmental coordination issues. Despite improvements in 2022, international tourism remained below pre-pandemic levels. International tourism experienced a more robust comeback than initially anticipated, driven by significant restricted demand and the alleviating or removal of travel constraints across numerous nations. The year witnessed over 900 million tourists journeying internationally, marking a doubling compared to 2021 figures, yet still reflecting a 37% decrease from the pre-pandemic levels of 2019 (United Nations World Tourism Organization [UNWTO], 2023). According UNWTO, in 2023, international tourist arrivals might attain between 80% to 95% of the pre-pandemic levels this year. In spite of offering socio-economic benefits, the tourism sector negatively impacts the environment and contributes to greenhouse gas emissions.

In this regard, the concept of Circular Economy (CE) has gained attention as an alternative economic model to address resource scarcity, climate change, and environmental degradation. Unlike the prevailing linear economic model, CE aims to optimize natural resources, reduce emissions, and create competitive business opportunities. However, research on CE adoption within the travel and tourism industry, particularly the hotel sector, is scarce despite its predominantly linear economic model.

This study focus on the Portuguese hotel industry and aims to examine its perspective on adopting CE practices and principles. By surveying 78 questionnaires, the study seeks to introduce new principles to an existing CE framework and contribute to scientific research within the travel and tourism industry, especially concerning the Portuguese hotel sector, an area that has been minimally explored to date.

## **2. The Concept of Circular Economy**

Presently humankind is dealing with several environmental risks and challenges that go from global biodiversity loss to pollution growth and climate change along with an increase in growth of income inequalities. Waste along with the overexploitation of natural resources by industries are also negatively impacting environment and contributing to this environmental, social, and economic emergency. Tackling these externalities and challenges is vital for companies, stakeholders, governments and ultimately for communities, as creating economic and environmental resilience is, as never before, of greatest importance.

The prevailing economic model is based on a linear paradigm (Rodriguez et al., 2020), in which resources are accounted for being abundant, consistently available, easily accessible, and cheap (European Commission, 2014), following the 'take, make, dispose' pattern (Ness, 2008) with natural resources being extracted and converted into goods and disposed of after consumers' utilisation as waste, replacing it by a 'make-use-reuse-remake-recycle' model.

This concept is based on a set of a miscellaneous collection of scientific and semi-scientific approaches, namely 'circular flow of income', 'cradle-to-cradle', 'industrial ecology', 'performance economy', 'biomimicry', 'eco-effectiveness and eco-efficiency', 'natural capitalism' (Costa et al., 2020), and was first introduced to the scientific community by Pearce and Turner (1990) as an attempt to address environmental constrains (Andersen, 2007; Yong, 2007). This concept distinguishes itself as a regenerative economic approach that minimises raw materials utilisation and waste as well as emissions, mitigates energy consumption by decelerating and closing energy loops (Geissdoerfer et al., 2017) and mimicking natural materials closed systems (Feng and Yan, 2007; Yang and Feng, 2008; Geng and Doberstein, 2008; Hu et al., 2011).

According to the EMF (2012) and the European Commission (EC) (2015), CE is an economic model that is 'restorative and regenerative by intention and design', where the value of products is maintained for extended periods of time, minimising the generation of waste, as the concept of 'end-of-life' is replaced by the restoration of products. The utilisation of energy from renewable sources as well as the mitigation of toxic substances use which impair the potential of recycling and reusing is also encouraged. These along with enhanced design of products and manufacturing techniques will certainly impact companies' performance, allowing them to attain sustainable development, which presupposes generating environmental quality standards so that the economic welfare and social equity of future generations are accomplished (Kirchherr et al., 2017).

Moreover, Circular Economy has been highlighted as a reliable economic model which allows companies to enhance their business through a more preventively and regenerative approach, by promoting a paradigm shift so that not only the negative externalities of the prevailing linear economic model are mitigated, but also to establish enduring adaptability and resilience and create opportunities for development while obtaining environmental and social advantages.

### **2.1 Circular Economy R-Principles**

For the past few decades, academia and stakeholders have utilized various R-principles. However, pinpointing the exact origins of these classifications has proven challenging, lacking a specific article as a definitive starting point (Sihvonen and Ritola, 2015; Yan and Wu, 2011). Zhu et al. (2010a, 2010b) and Reh (2013) view these R-Principles as sequential stages within the framework of a Circular Economy, establishing them as the foundational principles of CE.

In literature, CE is often represented by the 3R-principles: Reduce, Reuse, and Recycle (Ren, 2007; Feng and Yan, 2007; Sakai et al., 2011; Preston, 2012; Reh, 2013; Su et al., 2013; Lett, 2014). Over time, additional R-principles

gained attention. The European Union Waste Framework Directive (EC, 2008) introduced the Recover R-principle, expanding the initial 4R framework. Various academic contributions presented alternative R frameworks, such as the 6R (Sihvonen and Ritola, 2015), and even more extensive models like the 9R emerged (van Buren et al., 2016; Potting et al., 2017).

The diverse R-principles should be arranged hierarchically and prioritized based on their level of circularity (Kirchherr and Hekkert, 2017; Potting et al., 2017). They are viewed as strategies within circularity, enabling the reduction of natural resource and material consumption while minimizing waste generation. They are applied across different stages of the value chain. Within a CE framework, waste is regenerated, and these R-principles aid in continually cycling materials over time, reducing the need for raw materials by converting used ones into secondary raw materials. Figure 1 presents Potting's et al. (2017) interpretation of the 9R-principles, their prioritisation according to the circularity level.

In this ongoing study, we examined this classification; however, we expanded it by introducing the Redesign, Remine, and Return R-principles, forming a comprehensive set of 13R principles. Specifically, Re-educate and Redesign were included as R2 and R3, respectively, within the category labelled 'Smarter product use and manufacture.' Additionally, Remine and Return were designated as R12 and R13, respectively, falling under the category of 'Useful application of materials.' These newly introduced R-principles will be detailed in the subsequent sections as they were integral to the questionnaire distributed within the Portuguese hotel industry.

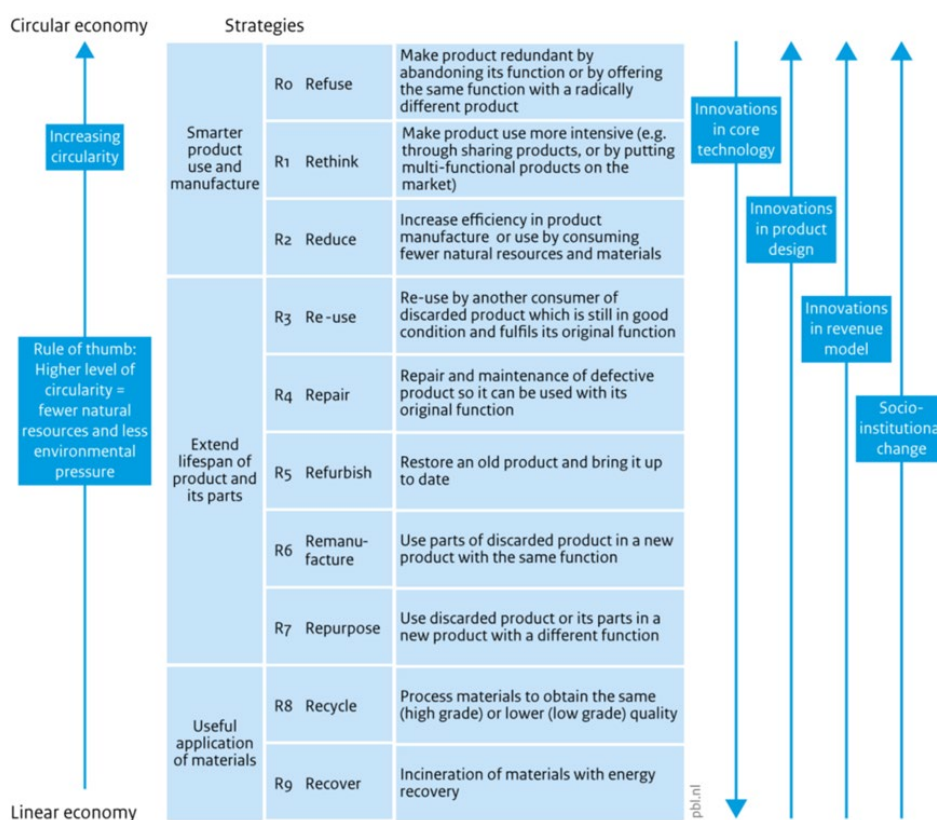


Figure 1: Potting's layering of CE R-principles (2017:5).

In Section 2.1.1, a study is conducted on R0-Refuse, R1-Rethink, R2-Re-educate, R3-Redesign, and R4-Reduce, showcasing their role in enhancing production and consumption methodologies. Moving to Section 2.1.2, the focus shifts to R5-Reuse, R6-Repair, R7-Refurbish, R8-Remanufacture, and R9-Repurpose. Section 2.1.3 explores R10-Recycle and R11-Recover. Lastly, Section 2.1.4 addresses the significance of R12-Remine and R13-Return.

### 2.1.1 R0-Refuse, R1-Rethink, R2- Re-educate, R3-Redesign, R4-Reduce

The concept of R0-Refuse is described from two distinct viewpoints: that of the consumer and the producer. From the consumer's standpoint, this concept relates to the opportunity consumers have to choose for reduced product quantities or diminish usage altogether (Miller and Spoolman, 2002; Black and Cherrier, 2010; Alwood

et al., 2011). It also encompasses rejecting packaging, bags, or containers when they contribute to waste (Clapp and Swanston, 2009; Kasidoni et al., 2015). Examining the producer's perspective, Bilitewski (2012) states that evaluating product design and lifespan is crucial. Designers possess the authority to refuse certain production strategies and processes that may lead to waste generation or the use of hazardous substances. R1-Rethink emerges as a design-oriented approach integrating ecological and environmental concerns into the design process to create "ecoeffective" products, aiming to dematerialize material flow systems. However, in the current economic model, even well-designed products are often discarded shortly after use. Some products are intentionally designed for short lifespans due to hygiene, cost, and convenience factors. This linear economic model has succeeded in providing mass-produced low-cost items but has also resulted in environmental externalities impacting the planet.

Within such an energy and resource-intensive economic system, the lack of product reuse represents a significant economic loss. Consequently, it becomes crucial to reconsider both production and consumption patterns, alongside design strategies, to transform how products are manufactured, used, and reintroduced into the system.

Contemporary consumers are increasingly aware of waste-related issues and display a heightened willingness to embrace reusing, recycling, and opting for durable products. They actively seek to support companies and organizations that adopt circular strategies, while simultaneously integrating circular approaches into their own practices. However, despite this inclination, they may encounter challenges in executing these circular practices. One major obstacle could be the lack of information or education on how to effectively implement circular approaches, preventing their active participation in circular practices.

Companies should prioritize adopting the R2-Re-educate principle and actively invest in establishing a solid institutional framework that fosters a circular mindset. This involves providing comprehensive information, cultivating awareness on CE, and shaping consumers' mindsets towards circular practices.

When considering the R3-Redesign principle within the CE model, it becomes crucial to recognize the shift from a 'cradle-to-grave' strategy to a 'cradle-to-cradle' design approach. This approach optimizes product life cycles to prevent premature disposal in landfills, ensuring that products fully utilize the opportunities offered by various R-principles.

Under a 'cradle-to-cradle' framework, products are designed and manufactured with a focus on longevity and produced through waste-free industrial processes (McDonough and Braungart, 2002; Geissdoerfer et al., 2017). In this context, CE emerges not only as a preventive model aimed at reducing natural resource depletion but also as a paradigm that respects the interconnectedness between industry and the natural environment (Cooper, 1999; Nakajima, 2000; McDonough and Braungart, 2002). This construct extends beyond mere sustainability; it accentuates efficiency through design and service provision, resulting in reduced inputs, diminished resource utilization, and a detachment from economic development paradigms.

The R4-Reduce principle, coupled with other R-principles, plays a pivotal role in alleviating the pressure and impact of the linear economic model on global resource reserves. Its primary objective is to minimize the consumption of non-renewable raw materials, favouring those that are renewable, biodegradable, or recyclable in production processes (Yong, 2007; Tse et al., 2015, 2016). This approach preserves natural resources while concurrently aiming to diminish energy usage during production and consumption phases, thereby reducing overall waste generation by enhancing process efficiency. Implementing this principle involves adopting more efficient packaging methods, resorting to modern technologies, and designing lighter and more compact products (Jun and Xiang, 2011). Ghisellini et al. (2016) emphasize that 'Reduce' signifies a reduction in resource consumption per product manufactured or substituting toxic substances with less hazardous alternatives. Furthermore, consumers can play a role by moderating their purchasing behaviours and reconsidering consumption patterns. Companies can actively contribute by lessening their reliance on raw materials and considering product design that emphasizes durability, reparability, and recyclability. Consequently, the R4-Reduce principle holds significant importance within waste management strategies.

#### 2.1.2 R5-Reuse, R6-Repair, R7-Refurbish, R8-Remanufacture, R9-Repurpose

Continual reuse and redistribution of products and materials in their original or slightly modified form to new users are essential (EMF, 2019). In an intentionally restorative economic system, the focus is on prioritizing R5-Reuse of products rather than discarding them prematurely before their full value is realized (Wijkman and Skånberg, 2015; Waste Resource Action Programme, 2016).

R6-Repair involves extending a product's lifespan (King et al., 2006) by repairing its components and parts (Stahel, 2010) or making necessary alterations (Thierry et al., 1995).

According to Lacy and Rutqvist (2015), prioritizing the R7 principles—Refurbish, long-lasting design, reuse, recycle, and remanufacture—in a CE model will bring significant economic benefits. These principles enable products to maintain their highest utility and value for extended periods, thereby enhancing the environment's natural regenerative capacity (Bastein et al., 2013; EMF, 2013).

Reike et al. (2018) describe R7-Refurbish as the process through which products, materials, or their components undergo upgrades. This involves replacing parts or components with a different structure, thus extending the lifespan of a specific product (Brito and Dekker, 2003; Fernández and Kekale, 2005). R8-Remanufacture, on the other hand, involves the upgrading of a product through repair. This process typically begins with a comprehensive inspection, followed by disassembly, cleaning, and repair using industrial processes conducted in supervised environments such as factories or workshops (Gehin et al., 2008; Lieder and Rashid, 2016). As for R9-Repurpose, it focuses on utilizing discontinued or obsolete components or parts of products for new purposes or functions, preventing their disposal in landfills. This approach allows these discarded goods to re-enter production processes, initiating a new life cycle with a different or modified function from their original design (Stahel, 2010; Yan and Feng, 2014; Reike et al., 2018).

### 2.1.3 R10-Recycle and R11-Recover

CE encompasses a spectrum of operations and actions focused on the reduction, reuse, and recycling of materials, following the R-principles. Recycling poses challenges due to certain substances present in products, complicating or rendering the recycling process nearly impossible. In an economic system lacking of equilibrium between matter costs and energy, the waste generated does not match the resources consumed—a disparity absent in a closed economic system where waste equals resource usage (Andersen, 2007).

R10-Recycle is notably less sustainable in addressing environmental challenges compared to other R-principles in terms of profitability and resource efficiency (Stahel, 2013, 2019). Certain industrial waste poses limitations to recycling, with some materials having only limited recyclability or being entirely unrecyclable (for instance, fibers can be recycled 4-6 times, certain metals pose recycling difficulties, and some plastics contain impurities hindering certain recycling processes) (Reh, 2013; Prendiville et al., 2014).

R11-Recover involves the "retrieval of materials after the landfilling phase" (Yan and Feng, 2014; Reike et al., 2018), which is a practice predominantly observed in developing countries.

### 2.1.4 R12-Remine and R13-Return

When operationalizing CE strategies, the R12-Remine and R13-Return principles often receive minimal attention. R12-Remine involves the retrieval of valuable materials from discarded items just before they reach the landfill phase. This process selects and reuses components for the production or remanufacture of new products or parts (García-Rodríguez et al., 2013; Reike et al., 2018). Meanwhile, R13-Return refers to environmentally controlled and non-toxic disposal of product components or parts, sometimes involving appropriate treatment or containment measures.

Circular Economy emerges as a strong framework for sustainability and development. However, critical examination, analysis, and ongoing research into its principles and implementation are essential. Table 1 displays the various R-principles considered and examined above.

**Table 1: CE R-principles considered for this study.**

STRATEGIES	R-PRINCIPLES	DESCRIPTION
<i>Better production and consumption approaches</i>	<b>R0-Refuse</b>	the refusal to approve packaging, bags or containers whenever they constitute waste; to accept or approve certain production processes; choose to purchase limited quantities of products or reduce its use
	<b>R1-Rethink</b>	a new and design oriented technique known as 'eco-effectiveness', so as to minimize and dematerialize the material flow system; promote an intensive use of products for longer periods of time
	<b>R2-Re-educate</b>	train and educate consumers to change their behaviour towards consumption

STRATEGIES	R-PRINCIPLES	DESCRIPTION
	<b>R3-Redesign</b>	products design and manufacture with a new purpose and with 'long-lasting' design through waste-free industrial processes
	<b>R4-Reduce</b>	minimise the amount of waste produced; decrease energy consumption in production processes; reduce the use of unnecessary packaging, and avoid disposable items
<i>Circularity higher degree</i>	<b>R5-Reuse</b>	use items and products as many times as possible
	<b>R6-Repair</b>	extend the lifetime of a product by replacing broken or damaged parts
	<b>R7-Refurbish</b>	it corresponds to the process that products undergo when upgraded, i.e. parts and components of a bigger framework have to be replaced so that the life cycle of the product is extended
	<b>R8-Remanufacture</b>	repairing a product, starting with an inspection, followed by the product disassembly, cleaning, and repairing, through industrial processes in monitored atmospheres
	<b>R9-Repurpose</b>	utilizing discontinued or obsolete parts or components and providing them with a new purpose or another function, enabling these discarded equipments to re-enter a new life cycle
<i>Advantageous utilisation of materials</i>	<b>R10-Recycle</b>	products are recycled by disassembling components and separating parts
	<b>R11-Recover</b>	retrieval of materials after landfilling phase
	<b>R12-Remine</b>	recuperation of materials before the landfilling phase
	<b>R13-Return</b>	the throw back of products or component in an environmentally innocuous way, which may include appropriate treatment and handling or even containment

### 3. Methodology

#### 3.1 Data Collection Procedures

This research utilized a quantitative approach through an online questionnaire within Portugal's hotel industry to explore its perspective on CE practices and R-principles. The study focused on 1407 hotels across various regions of Portugal and collected responses from April 16 to July 7 2021, primarily via emails from the visitportugal.com site and social media channels. Despite attempts to reach hoteliers during a national lockdown, only 78 usable questionnaires were obtained. The study concentrated on CE R-principles and practices, using Likert scales and various types of questions across 20 questions divided into eight sections. The research aimed to investigate which R-principles and CE strategies were being implemented by the Portuguese hotel industry. Specifically, it aimed to answer two research questions: 1. Which R-principles are implemented by Portuguese hotels? 2. What CE strategies are already in place within the Portuguese hotel industry?

#### 3.2 Data Analysis

The study employed descriptive statistics to analyse response variability and detect missing data in the questionnaires. To evaluate the internal consistency of survey items, Cronbach's alpha ( $\alpha$ ) was used, with a value above 0.7 generally considered acceptable, though some researchers accept values above 0.6. For the overall survey, a recommended Cronbach's alpha is at least 0.9. Additionally, the average inter-item correlation (AIIC) was utilized to assess correlation among items within a composite, with a range of 0.15 to 0.5 considered standard. Both Cronbach's alpha and AIIC were applied across five constructs to confirm if respondents consistently answered items within each construct. The findings indicated high internal consistency, suggesting the questionnaire's overall reliability.

#### 3.3 Results and Discussion

This section addresses the research questions outlined above and presents a discussion of the primary findings derived from the quantitative approach analysis.

##### 3.3.1 Respondents' Profile

The survey respondents in the hotel industry consisted of various roles such as managers, CEOs, directors, and owners. The distribution of questionnaires across different regions showed that 3.9% of hotels were from the Azores, 5.8% from Madeira, 8.7% from the Algarve, 9.7% from Alentejo, 16.5% from Porto and the North region, 25.2% from the Lisbon region, and 30.1% from the Centre of Portugal. In terms of star ratings, 1.1% were one-

star hotels, 11.5% were two-star hotels, 29.9% were three-star hotels, 51.7% were four-star hotels, and 5.7% were five-star hotels. Ownership structure revealed that 96.7% of hotels were national companies, with 3.3% being international. Additionally, 66.3% of accommodations were independent, while 33.7% were part of a hotel chain.

### *3.3.2 CE R-Principles Adoption by the Portuguese Hotels*

The survey participants, including hotel managers and CEOs, assessed the implementation of various R-principles in their companies using a Likert scale. The survey results indicated strong implementation of Repair (100%), Recycle (98.65%), Reduce (97.30%), and Reuse (90.50%) practices, while Remanufacture, Return, Refuse, Redesign, Rethink, and Refurbish were identified as the least implemented R-Principles.

The study emphasized the significance of the 3R-principle (Reduce, Reuse, Recycle) along with Repair in preserving the environment and shifting from a linear to a CE model. The application of these principles aims to extend product lifespans, emphasizing clean manufacturing and green supply chains.

The survey revealed that respondents primarily focused on enhancing energy, water, and waste efficiency in line with the 3R strategy commonly used in the travel and tourism industry. Recycling, water, and energy management were the most prominent measures adopted by companies, while renewable energies, product design, refurbishment, and reuse received less priority.

Implementing measures such as recycling, managing water and energy consumption, and minimizing waste not only reduces operational costs but also aligns with environmental objectives like achieving carbon neutrality by 2050. Initiatives focusing on cleaning management and reusing towels and bed linens cater to the growing preference for sustainable alternatives among visitors.

The survey respondents reported implementing water and energy management policies and waste management strategies in their companies. However, a lower percentage considered procurement of products designed according to CE principles, indicating potential areas for improvement in embracing its practices.

Overall, companies actively employed strategies such as recycling, water, and energy management, aligning with existing literature. These initiatives have the potential to reduce consumption, emissions, and operational costs while simultaneously reducing environmental impact, corroborating previous research findings.

## **4. Conclusions**

This study contributes to the existing literature on Circular Economy implementation in the hotel industry, offering country-specific data for potential cross-country comparisons. However, the response rate from the questionnaire might restrict generalizing findings to the broader Portuguese hotel industry.

Existing literature emphasizes CE's potential to optimize resource use, reduce emissions, and create business opportunities. However, there's limited research on CE implementation in the Portuguese hotel industry.

Findings reveal that participant companies prioritize CE R-principles, especially the 3R-principles (Reduce, Reuse, Recycle) and Repair, forming the foundation of their environmental strategy. Companies focus on environmentally responsible materials, waste, energy, and water management, recycling, employee education on sustainability, and towel/bed linen programs.

The study highlights companies' emphasis on the Reuse principle, extending product lifespans and reducing ecological footprints.

This research aims to promote, understand, and highlight strategies for enhancing CE implementation within the hotel industry. Understanding current CE concepts can help companies differentiate strategies and gain competitive advantages. Insights on companies' awareness and attitudes can drive successful CE initiatives.

While achieving its goals, the study's response rate may limit broader generalization. Future research could involve a larger pool of companies and explore customer satisfaction with CE practices for a more comprehensive analysis.

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