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Evaluating the Circular Economy Approach for Waste Management and Resource Conservation: A Comparative Analysis of Green Practices in Different Industries

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Abstract

The transition closer to a round economic system has emerged as a critical vital throughout numerous industries, pushed through the recognition that sustainable practices can safeguard environmental well-being whilst fostering long-term prosperity. This study's paper conducts a complete evaluation and comparative evaluation of worldwide inexperienced practices adopted through numerous industries, using the qualitative procedure. The number one objective is to empower stakeholders, ecosystem participants, and society at big to suggest for the formula of regulations and the implementation of exemplary round economic system practices. The core principles of the round economy emphasize sustainable, useful resource management, waste minimization, and the merchandising of renewable energy. The benefits of this technique encompass value savings, efficient useful resource usage, and a closed-loop system that maximizes product utilization and refinement. However, the feasibility of the round financial system is contingent upon supportive coverage, legal, and economic frameworks. The paper examines various inexperienced practices applied by manufacturers, which include recycling, reusability, fabric, and power efficiency, reverse logistics, and the integration of waste as by-products or feedstock. Additionally, the take a look at explores the crucial position of patron recognition in using shopping for decisions in a waste-aware economy. The comparative evaluation throughout industries exhibits the key overall performance indicators (KPIs) that decide the effectiveness of circular economy practices, providing treasured insights for stakeholders and policymakers.

Keywords: The Circular Economy Approach, Waste Management, Green Practices in industry

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1. Introduction

The circular economy can be considered essential for effectively managing increasing waste generation and conserving limited resources. Literature across industries commonly concerns the concept of the circular economy because of the mounting idea that green practices are not only to protect the environment but also to set a path for an industry's long-term sustainability. Though different sectors have been perceived in the literature for their particular waste sustainability approaches, in the absence of research, their findings are often non-comparable to assess the effectiveness of their waste recycling strategies qualitatively or quantitatively.

This paper primarily aims to analyze and compare different industries' green practices internationally with qualitative and quantitative approaches by narrowing down some secondary objectives. The objectives and questions framed are justified based on some initial findings. Therefore, the industry reports outcomes are prioritized on which case studies of best green or recycling practices are still a future direction. At the same time, it can help worldwide stakeholders, ecosystem participants, and society to advocate for drafting policies or penetrating market areas to implement the best practices in different industries.

In waste management, the era of circular economy is a transformational period based on the industrial sustainability model toward minimizing the effects of ecological risks. Sustainable waste management is currently difficult and will continue to be so. The lack of a policy governing the disposal of waste has been seen in developed countries until a significant challenge had to be activated. Despite the recycling percentages, there are variations between these countries. The economic, political, geographic, and sociological conditions, as well as cultural preferences, all play a role. For disposal and emergency barricading, some industrial sectors find landfills to be low-cost options, whereas it is risky for the receiver and organizations as well.(Hemidat et al.2022).

Expanding upon these ideas, it is important to recognize that the circular economy offers a comprehensive solution to the pressing issue of escalating waste production and the preservation of scarce resources. Extensive research across various sectors consistently emphasizes the significance of adopting circular economy practices, driven by the realization that sustainable practices not only safeguard environmental well-being but also pave the way for long-term prosperity within industries. However, due to the dearth of studies, comparing the effectiveness of waste recycling strategies from different sectors remains a challenging undertaking, both qualitatively and quantitatively. (Salmenperä et al.2021)

Considering this backdrop, the primary objective of this paper is to conduct a thorough analysis and comparative assessment of international green practices across diverse industries utilizing qualitative and quantitative approaches. To achieve this objective, several secondary objectives and research questions are formulated, which are predicated on initial findings. Consequently, the priority of industry reports is placed on identifying case studies exemplifying the best green and recycling practices, which can serve as a blueprint for future endeavors. Simultaneously, this undertaking aims to empower stakeholders, ecosystem participants, and society at large to advocate for the formulation of policies and the

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implementation of exemplary practices within different industries. (Kotyal, 2023)

Within the realm of waste management, the advent of the circular economy represents a transformative period, epitomizing the industrial sustainability model's commitment to minimizing ecological risks. However, it is crucial to acknowledge that sustainable waste management is an inherently complex task, one that is beset with challenges at present and is expected to persist in the future. Developed countries have grappled with the absence of a comprehensive waste disposal policy until faced with significant challenges that necessitated immediate action. Despite variations in recycling rates among countries, multifarious factors such as economic, political, geographic, sociological conditions, and cultural preferences contribute to the observed fluctuations. Furthermore, while some industrial sectors perceive landfills as cost-effective options for waste disposal and emergency containment, this approach carries inherent risks for both the recipients and the organizations involved (Haque et al., 2023).

2. The Concept of Circular Economy

In recent years, the idea of the circular economy has been widely discussed and analyzed. Many scholars and practitioners have emphasized the importance of addressing modern waste management and resource use issues using the framework of the circular economy. At its core, the circular economy suggests an alternative to a linear, wasteful approach. It aims to maintain a sustainable stock of resources in the economy, minimize waste of resources, use resources optimally, and promote renewable energy. In general, the circular economy is seen as a restorative and regenerative system whereby not only can we reduce waste and retain materials, energy, and resources in the economy, but we can also create and develop innovative business models to do so. Some labels in this context include cradle-to-cradle, blue economy, regenerative design, or performance economy. (Blomsma & Tennant, (n.d.)).

Even though the very term 'circular economy' might be interpreted in various ways in society, we discuss it broadly as an economy having characteristics that minimize waste, pollution, carbon emissions, energy consumption, and enhance equity between social and financial development. In the traditional linear approach, goods are produced, used, and disposed of as waste. Such an approach leads to generating waste, creating long-term environmental damage, and causing irreversible harm to some ecosystem services. In the circular economy, such long-term damage is supposed to be minimized by sustainable design practices and by establishing an industry that prioritizes the possibility of restoration and regeneration. The benefit stemming from such an approach is cost savings, which are a result of more effective management of materials and energy. The system is a closed loop and focused on a high level of usage or refinement of used products. Products can be used, sometimes in a degraded form, to avoid the final disposal of a particular product, part, or material. One of the key approaches is valorizing secondhand goods, their components, or remanufacturing and recycling capital. (Yang, et al., 2023).

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2.1. Definition and Principles

Substantial literature is now available on the concept of the circular economy, which has become one of the hot topics in sustainable development and environmental management in correlation with the linear economy. Current misconceptions about the circular economy make it complex to analyze the similarities and divergences of its concept across industries and the impact at an industrial level. Given this increasing interest, a conceptual framework of the circular economy seems to be valuable knowledge expected by practitioners and other researchers. This scientific contribution takes a different approach, working from the other side of the analysis. (Alhawari, Awan, Bhutta, & Ülkü, 2021).

The concept of the circular economy has emerged as a proposed shift in the historical paradigm of industrial development, from a linear economic model to the circular one. Therefore, there is no need to treat or transform the existing economic structure, but deeper changes should be carried out in the way resources are saved and not overused. Generally, the circular economy principle can be graphically shown in three dimensions. Based on these dimensions, the circular economy can be conceptualized by some key definitions. More specifically, the circular economy can be defined as a new economic model based on long-lasting and reused or recycled products to produce new products. It requires greening, re-internalization, and de-risking of supply chains, and implies a role for consumers and a need to move away from business as usual. (Sverko Grdic, Krstinic Nizic, & Rudan, 2020).

The preference for sustainability as the core issue around the circular economy reflects the interest in circular principles with the closed-loop system at the macro-level process, contributing to increased financial savings. This use of resources for production can support lessening, reducing, or reusing-substituting physical and energy inputs where such inputs keep the optimal stock constant or increase. Accordingly, the approach can advance in preserving natural capital. In terms of consumption patterns, the circular business model could push the shift from demand-driven to needs-driven production, which focuses on creating fewer, more durable jobs. This shift leads to a joyful life and supports the push in suppressing excessive materialism. Business operations can be supported by aligning commercial interests with circular economic business models that enable the efficient use of shared and/or access-based products. (Charnley, et al., 2024).

2.2. Benefits and Challenges

In the current literature on the circular economy (CE), numerous potential benefits are mentioned as possibilities of adopting a CE. One of the main benefits lies in the reduction of resources, materials, and energy use in the economy, replacing the demand for virgin resources with secondary or renewable resources. This increased resource efficiency in firms contributes to the reduction of operational expenses and, as a consequence, increases the net operational profits. Furthermore, the reduced use of virgin inputs and decreased disposal of waste contribute to a reduction of the environmental footprint of the firm and, potentially, the economic activities in which it participates. Consequently, CE is seen as something that would contribute to firms iteratively moving towards increased social and environmental

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sustainability. CE practices may also lead to the creation of social or economic value on a more general scale. (Pauliuk, et al., 2021).

This value spillover could be an increase in the attractiveness of a particular location for firms to invest in localized economic development, the creation of jobs in green or sustainable sectors, social equity and cohesion, and a reduction in crime rates, particularly in instances where firms and other stakeholders invest in community-level socio-environmental initiatives. A CE framework could not be complete without a conversation around the challenges of adopting CE practices. There are a range of challenges that firms face when transitioning to a model with resource reduction as its core. The first and possibly most significant one is the very high capital cost investments that are often necessary for infrastructure that is not only sustainable but circular. Where exceptional leadership and vision are not present, the risk and lack of information regarding the expected outcomes act as a barrier to investment. In many instances, secondary or already processed materials are not yet available at a scale to be used as raw materials, and many potential users do not have the procurement guidelines and risk management strategies to support purchasing them or using them as inputs. Additionally, stakeholders at all levels are hardened into an existing mode of doing business and infrastructure, to such a degree that many are not able to operate in the same way within the timeframes CE requires. It is clear that without overarching policy and legal frameworks, as well as shifting financial services towards circularity, CE will for the most part be a non-value-adding or even unfeasible exercise for most firms. (Hossain, Ng, Antwi-Afari, & Amor, 2020).

3. Green Practices in Various Industries

The understanding of sustainability varies significantly across different sectors, reflecting the unique challenges and opportunities each faces. Consequently, the methods through which companies implement environmental improvements can differ widely, leading to the emergence of best practices that are often sector-specific. For instance, industries such as manufacturing, agriculture, and services may prioritize different green initiatives based on their operational models and environmental impacts. Green practices are not merely about compliance; they address industry-specific challenges such as diversity in supply chains, production capacity constraints, and the nature of service delivery. In the manufacturing sector, for example, companies may focus on reducing resource consumption and emissions through advanced technologies and process optimization. In contrast, the agriculture sector may emphasize sustainable land management and organic practices to enhance soil health and biodiversity. The various green initiatives adopted by companies play a pivotal role in improving waste management and optimizing resource use. They often involve restructuring operations to align with the principles of a circular economy, where the emphasis is on minimizing waste and maximizing the lifecycle of products. The circular economy model encourages businesses to innovate in ways that reduce reliance on finite resources, thereby fostering more sustainable production and consumption patterns.

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Key practices within the circular economy include implementing energy-saving methods, reusing materials, and adopting zero-emission strategies. For instance, companies might invest in renewable energy sources, enhance recycling programs, or explore product-as-a-service models that extend the lifecycle of products while minimizing waste. These strategies not only help close the materials loop but also contribute to the broader goal of protecting natural habitats and preserving essential resources. Moreover, as organizations commit to sustainable practices, they often find that these initiatives lead to additional benefits, such as enhanced brand reputation, increased customer loyalty, and long-term cost savings. By integrating sustainability into their core business strategies, companies can drive innovation and create competitive advantages while fulfilling their responsibility towards the environment. (Pellegrini, Campi, Locatelli, Pattini, Di Giuda, & Tagliabue, 2020).

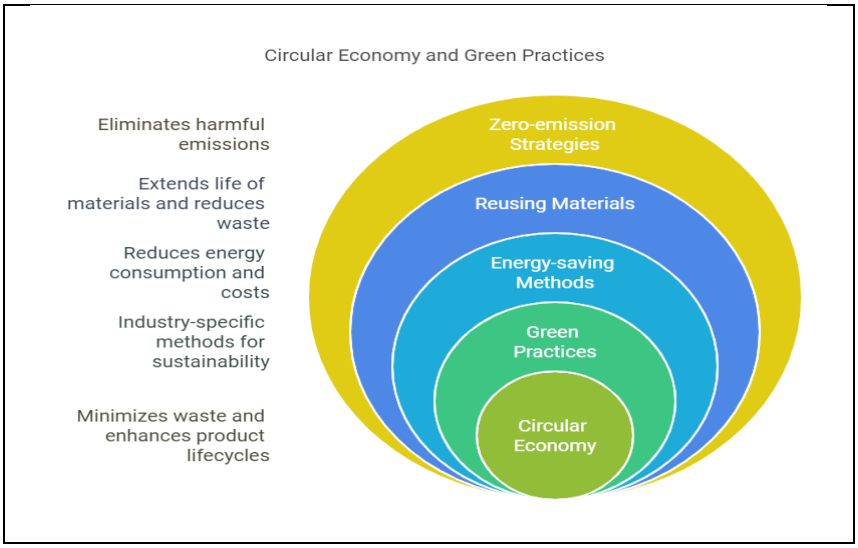

Figure 1: Circular Economy and green Practices

Figure 1 shows that practices are also informed by various policies to promote the circular economy, which drive sectoral diversity by fulfilling policy targets for the collection, recycling, and recovery of waste and encouraging innovation and upcycling of creative technologies. There are several points of view on green practices that showcase waste minimization and resource efficiency in various sectors. For example, luxury goods perform repairs for their items to extend their life; paper sectors, while major users of water, use the bulk of water from their industrial processes as a waste to cultivate forests. Car manufacturers utilize robots for welding, assembling, and painting processes to lower the risk of waste production; a subsidiary has developed technology to convert scrap tires, which are waste, into durable bins. Another company has used bars to produce complex car parts for car bodywork from durable polymers. The product is made from plastic bottles, thereby encouraging the beneficial use of waste. With such methods, companies also eliminate waste, generating revenue. (Joensuu, Edelman, & Saari, 2020).

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3.1. Manufacturing Sector

In the circular economy, materials are reused, maintaining their value; thus, eliminating waste. In the circular economy, manufacturing plays a significant role in closing resource loops, as evidenced through the increasing adoption of green practices by manufacturers. Manufacturers have shown more interest in opening the black box of product and process systems for identifying major environmental issues associated with them, facilitating informed decisions that reduce hazardous impacts on the environment, and closing the loop by including the end into consideration. Resource cost pressure, market opportunities, and resource scarcity have accelerated the transition to a circular economy. The structural shift aims to close the production cycle loop by minimizing, reusing, and recycling waste streams; so far, successful examples are limited. (Awan, Arnold, & Gölgeci, 2021).

Manufacturers have heavily invested in incorporating various kinds of green practices, such as recycling, reusability, material and energy efficiency measures, reverse logistics, design for environment, product take-back, and using specific waste as by-products or feedstock for energy recovery. At the manufacturing stage, there are three major green practices: (a) recycling materials to create by-products, (b) improving production processes for increased efficiency, and (c) utilization of waste. In addition to the circular economy case studies, a list of practice cases can be found about the manufacturing stage, in flange systems, industrial ovens, and customized steel. These manufacturers have adopted green manufacturing, recycling by-products, and waste minimization. To some extent, it is more practical for green practices to be applied in the manufacturing stage. In addition, green innovation can solve some of the barriers that appear in the primary stage; however, it can also introduce new barriers. Green practices at the manufacturer level involve various technologies, including the adoption of new processes, practices, infrastructure, and capital investment. (Karuppiah, Sankaranarayanan, Ali, Chowdhury, & Paul, 2020).

The use of waste, water, and energy may create potential environmental risks; thus, state-of-the-art facilities and practices are applied to ensure these programs are managed in a responsible manner to protect the environment and human health. Regulatory pressures such as extended producer responsibilities and end-of-life directives, the growing environmental concern of consumers, and basic needs for controlling supply chains of rare earths in industries such as automotive producers are stimulating investments in tracking opportunities for closed-loop opportunities. An environmental strategy for manufacturing can reduce life cycle costs but increase demands on suppliers because products are designed for easier use and recycling—recycling may save some non-renewable materials, especially a short payback investment. Converting manufacturing output for a useful purpose or recycling—generating less waste—would be more important if the critical material is tied to strategic supply constraints plus demand pull. The basic raw materials bottlenecked or not substitutable include elements like indium/germanium, which are present in multiple components of membrane materials; cobalt/nickel; and lithium. The metal recyclability rate varies from industry to industry; however, for the manufacturing sector, the recycling rate is about 66%; this percentage could be reduced without waste. (Krauklis, Karl, Gagani, & Jørgensen, 2021).

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3.2. Food and Beverage Industry

With rising consumer awareness related to food waste, resource depletion, and other sustainability issues, companies have begun to address these concerns in several ways. One possible solution is to practice the circular economy approach of waste management and resource conservation. In the food and beverage industry, the adoption of such green practices is of particular importance. A range of strategies has been adopted by companies to address the issue of food waste in different ways. The practices include, but are not limited to, developing new products from food waste, reducing waste through the use of durable packaging, reusing organic waste through composting, raising awareness of the issue of food waste, and finding innovative ways to minimize waste. (Awan, U.; Sroufe, R., 2022).

In fact, some food and beverage companies go to great lengths to ensure that their supply chain is committed to sustainable and responsible sourcing practices. They emphasize the use of whole ingredients and spices to attract customers to their sustainable story. Their products contain ingredients such as oranges, dates, and apples that are still of good quality but would normally be discarded as food waste. This commitment to reducing waste right at the source is critical. All these strategies are good and well, except that a standard format must be adopted by the state—national and international—to intercept food waste. The idea of capturing organic food waste would generate sustainable value only if everyone were on board. (Adams, Donovan, & Topple, 2023).

3.3. Retail and Consumer Goods

Consumer-Facing Operations The retail and consumer goods sectors play a significant role in the transition from a linear to a circular economy through green practices at both the operational and consumer-facing ends of the industry. Retailers are acting on multiple opportunities to make operations more efficient and invest in recycling and advanced waste treatment—practices that reduce or keep the management of material outflows to a minimum. At the operational end, activities include food waste diversion through donation or recycling, installation of on-site green infrastructure to manage stormwater, recycling traditional materials like paper and plastic, comprehensive lifecycle stewardship for consumer returns, and take-back programs, such as electronics recycling. As the public has become increasingly aware of their environmental footprint and the relative environmental benefits of replacing traditional packaging with more sustainable options, an increasing number of retailers have adopted sustainable packaging strategies, including the development of a company-wide packaging policy or specific guidelines. (Gong, Putnam, You, & Zhao, 2020).

Consumer acceptance of products, which drives buying decisions, is critical in a waste-aware economy. While a company is in control of the packaging materials used for a product, a variety of factors influencing consumer behavior and, by extension, decisions to purchase a product become challenging. From inception and after the launch of a product in the marketplace, companies must deliberate on ways to incentivize sustainable behavior and educate consumers on the lessons of reduce, reuse, repair, and recycle. This involves decision-making on product design attributes such as recyclability and take-back, label know-how,

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which may include a rating system to access product details by using information technology, and after-purchase engagement in a company's circular business model. The global transition to a circular economy involves embedding principles into the lifecycle management of products, including supply chain sustainability. Numerous retailers offer packaging designed to convey a positive post-purchase experience to the consumer. Marketing callouts such as "100% plant-based wrappers," "compostable cups," and "eco-friendly utensils" catch people's eyes. The perception of environmental stewardship drives customers into their businesses, either online or in-store. Successful integrated marketing strategies eschew "eco-chic" as one-off trends and instead appeal to product performance, convenience, and culture as fundamental shifts rather than fleeting affinities characterized by transient sustainability. (Mutai, 2024).

The potential for additional marketing capital to be drawn from sustainable retailing is expansive. Brand expertise in environmental sustainability may be leveraged to promote services like order-ahead kiosks and seating in mobility-friendly locations. Creative contributor and relationship marketing can be used to carve distinctions among competitors like fast-casual chains and quick-serve restaurants. Nevertheless, there is significant power in informational value. The transition of an existing linear practice, like styrofoam packaging, to a more circular option, particularly in an online format, can be a strong educational tool. The estimation is that an interested person who reads and engages with information on a product profile is that a motivated shopper is more likely to participate in other circular economy-positive activities. An interested person is likely to support a retailer in-store and is more likely to be a committed advocate online for a company's sustainable practices. The study estimates that an invested person, defined as one who interacts with a brand's circular economy values and practices, in-store or online, is likely to return to the retailer for future purchases, and are highly likely to shop with the brand versus an industry competitor. (Neves & Marques, 2022).

4. Comparative Analysis of Green Practices

In this section, we discuss the various green practices employed across multiple industries before comparing their effectiveness for pursuing the circular economy approach. For example, within the context of waste management and resource conservation, buying back products and extracting valuable materials from them once they have reached the end of their life cycle is a promising approach. Some industries have already been working in this vein for many years, while others have only recently shown an interest in attaining sustainability. A comparison of green practices in different industries also poses a new way of thinking about this approach and may provide benefits for developing practical support mechanisms for adopting good practices across multiple industries. Regulation is one of the most salient factors that may influence the adoption of different practices between the various industries. It is notable that the role of logistics is varied in the considered cases. (Janssen, Weerakkody, Ismagilova, Sivarajah, & Irani, 2020).

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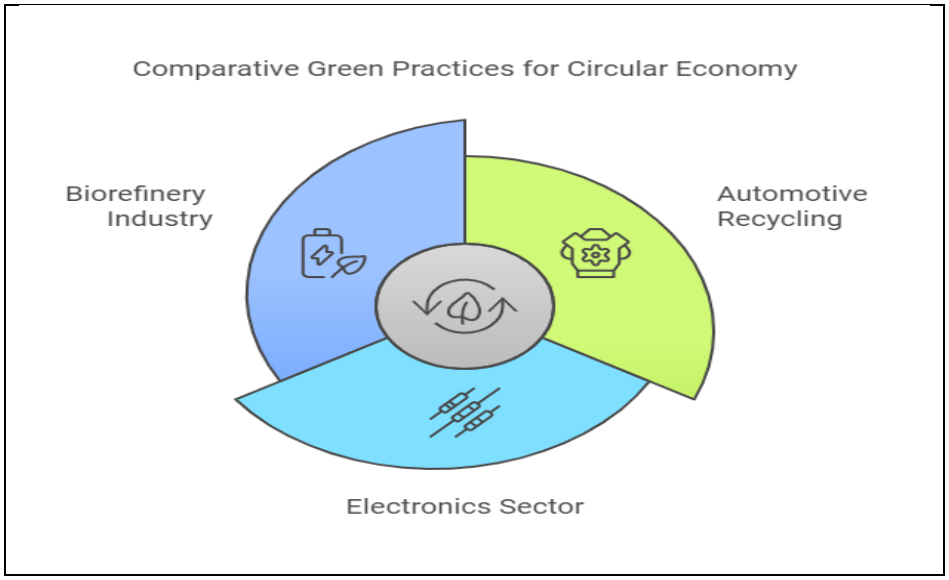

Figure 2: Comparative Green practice for Circular Economy

As shown in figure 2, the effectiveness of a practice will be evaluated through its impact on a number of indicators that are relevant for each industry and can give meaning to efforts made in a given area. The automotive recycling sector, which has been emphasizing material reusability, has the following key performance indicators: the lowest prime cost of available original spare parts; the highest proportion of recycling of end-of-life vehicles in the region; the biggest throughput of end-of-life vehicles in the region; the largest number of locations for end-of-life vehicle receiving points. In the electronics sector, the following indicators are relevant to the industry: whether the organization is recycling-oriented impacts the future of our community – a legacy that impacts both our natural environment and public health. In the biorefinery industry, the amount of renewable resources utilized and the amount of energy substitutes for fossil-related materials can be used as KPIs from a circular economy point of view. (Kanellou, Alexakis, Kapsalis, Kokkinakos, & Askounis, 2021).

For some time now, a number of industries have been making efforts to operate more responsibly with the planet's resources, using them in a more sustainable way. Their sustainability actions are as varied as their industries, since these actions are often governed by the specific pressures placed on individual industry sectors. Agriculture has more options to produce less environmental impact, health services have more mandate to address air quality, and manufacturing plays a bigger role in offering safe, efficient products. Therefore, it is unlikely that any one industry "best practice" will map universally across industries. Indeed, some care must be taken when translating a good idea from one industrial context into another. The application of these practices is dependent upon many factors, such as drivers, business leadership, and culture. This is not to say that we should not necessarily think or canvass ideas from one industry to apply them to another. Indeed, considering multiple options and solutions can identify areas of common and different challenges between industries, established innovations, and therefore facilitate a better understanding of best practices. This discussion paper draws on the comparative analysis of green practices between

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a range of industries stemming from circular economy and resource management/sustainability. A holistic approach is desired that defines the success factors and measures of industry to venture into resource conservation. (Qiu, Hu, & Wang, 2020).

4.1. Key Performance Indicators (KPIs)

The measurement of the performance of circular economy practices is critical to enhance the understanding of improvements in resource efficiency, waste reduction, and recycling. Key Performance Indicators (KPIs) are quantifiable measures used to determine the effectiveness of performances against specified goals. They are generally useful in evaluating the process and controlling outputs. KPIs are considered a good tool for setting targets, strategic planning, monitoring, driving change and improvement, and building accountability and standardization. Furthermore, they enable employees to know and understand the organizational vision, strategies, goals, and actions. Despite their potential benefits, KPIs should be used conservatively as a management tool as part of a broader program of performance measurement. With the overemphasis on them, a risk might arise that the social, economic, and environmental outcomes are collected simply because KPIs demand it, while the information may have no significant value and can be misleading. (Khan, Zia-ul-haq, Umar, & Yu, 2021).

KPIs used to monitor the circular economy concept can range from waste generation and landfill or incineration rates to the percentage of material being reused, recovered, or recycled. KPIs can differ between sectors based on their industries' particular circumstances and goals. Identifying KPIs specific to various sectors can measure systemic change and improve evaluation issues. Furthermore, implementing continuous monitoring is a critical part of realizing the goals and objectives for a circular economy. Some KPIs focus on environmental indicators, while others can generate appropriate KPIs related to business activities. In addition, company-level KPIs to monitor circular economy applications provide benchmarks and enable organizations to track and adjust educational and promotional strategies. In general, applicable KPIs are those that can be utilized to monitor processes or results, set targets, measure effectiveness, and inform management as well as stakeholders of outcomes. (Contini & Peruzzini, 2022).

Empirical findings expose the KPIs demanded in practical applications across different industries. In the Danish Construction and Housing Association, it is declared that the KPIs are necessary for the industry to work with the circular economy in a coherent manner. The construction industry in the UK requests indicator data for the practical application of green building. A series of KPIs enable all food companies to measure all food as well as subtract the waste generated. One of the companies has indicated that it is challenging to collect data for KPIs in some areas, as it depends on the entire batch of suppliers for their data. It has also been reported that warehousing and fleet companies face difficulties in collecting data to measure the percentage of single delivery runs made by company vehicles representing the whole vehicle capacity. Uniformity and standardization challenges for the application of KPI models of the circular economy are present, as well as difficulties in the interpretation of

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numeric percentage results. (Uddin, Popesko, Papadaki, & Wagner, 2021).

5. Case Studies and Best Practices

This section highlights some successful practices in industry for conserving resources and minimizing waste. This is not an exhaustive list of the good practices and case studies on sustainable waste management. Based on case study and best practice example experiences and findings, a few examples of how organizations are putting some parts of the circular economy into practice are summarized. Each case study describes the challenge or problem illustrated, the strategic and/or management innovation implemented, and the evidence of how well this has worked, mostly based on independent evaluation.

Challenges are presented: in principle, these strategies could be allied to a variety of industrial technologies. By studying a variety of sectors that are quite different, the case studies illustrate that the practical application of resource-saving approaches to waste and waste-based materials (on product, business, and system scales) is highly influenced by the context and current practices that develop historically and socially within particular industrial ecologies. They do not attempt to evaluate the case studies in any universal sense in terms of economic or environmental costs and benefits, only in terms of how well organizational/enterprise risks have been managed. Case studies illustrate a range of large organizations. These demonstrate some of the commercial opportunities for competitors in other sectors that might result from the reduction of risk through implementing responsible resource management and use. Leaders are presenting responsible and commercially viable long-term solutions to their staff, shareholders, and regulators, and are also educating future local and global skilled workers. They are not taking the risk of getting ahead of legislation and so ‘locking up’ innovations with patents, but are working person to person with others in their sectors on industry standards that attract innovators and skilled workers. In essence, the leaders are managing to create commercial value by converting locally developed responsible waste management costs into enterprise risks for competitors. Industries analyzed are manufacturing, pharmaceuticals, electrics, electronics, telecommunications, and finance. Manufacturers: all companies in this case study have successfully developed innovative strategies to use waste-fed supply loops and incorporate disassembly-friendly design in their products. (Sun & Zhang, 2022).

The point is that resource-conserving systems may save money, but they also create entirely new areas for business and analysis in the construction of the new product systems, services, partnerships, and markets that substitute for landfill.

The overall systems approach potentially affects everyone in the supply chain, i.e., the whole industry, long term. Regulatory, legislative, and technical demands on the industry are increasingly requiring a globally cohesive and transparent approach showing clear evidence of environmental responsibility in waste production as well as a careful environmental and social audit of waste causes via value chains and customer markets. (Tsai, Bui, Tseng, Lim, Wu, & Mashud, 2021).

As regards the pre-competitive attitudes requiring anonymity in case study writing, it is believed that good business logic and strategic focus leave space for many to compete in

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resource-saving activities; a number of sectors are big enough to attract many doing this if the benefits are good. Know-how in these ways is not seen as a source of competitive advantage in this study and is an example of a case where willingness to share internal overview is present.

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