

Circular Economy Ideas for Sustainable Management of Automotive Waste: Evidence and Lessons for Closing Policy and Legal Gaps in Zimbabwe

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Abstract

The automotive industry has significant anthropogenic impacts on the environment yet the extent to which circularity strategies for the automotive industry sector are elaborately crafted in Zimbabwe is not known. To address the gap between circular economy principles and the reality in Zimbabwe, a qualitative research approach was used to explore circular economy ideas for managing solid automotive sector waste. Findings show that pioneering literature on circular economy strategies represents a largely European and Asian bias while literature on circular economy ideas on Zimbabwe is just emerging. Findings further show that circularity has various context specific definitions and therefore no universal understanding of the concept exists. Additionally, findings show that circular economy strategies in developing countries are fragmented and even though several strategies exist, they require supportive social, legal and regulatory systems to be successful. The study also establishes that circularity has overshooting effects on sustainable environment management but lack of awareness about circularity principles results in restrictive approaches that further complicate solid automotive waste management in developing countries. The study concludes that circularity is an innovative route to achieve sustainable solid waste management in the automotive sector. Based on these findings, a circular economy model for the automotive sector is proposed. The study finally recommends that the circular economy concept as well as the drivers and barriers to its implementation must be understood upfront and should inform creative green policy thinking that supports the adoption of the proposed model to realize the benefits of circularity.

Keywords Automotive Waste · Circular Economy · Environment · Sustainability · Zimbabwe

1. Introduction and Context

Circular economy (CE) ideas are fast penetrating all sectors of the global economy due to resource scarcity and growing waste management challenges. Bui et al. (2025) underline that CE implementation is now receiving immense attention from industry practitioners and is seen as an indispensable way of promoting long term viability and resource conservation. Despite this popularity, efforts to implement CE are not yet widespread (Montocchio et al., 2025) hence a growing solid waste management crisis in African countries as acknowledged by Shabani et al. (2023). In the words of Muzamwese et al. (2024) the waste management crisis is now a burgeoning environmental sustainability crisis. Accordingly, the interest to develop sustainable and smart country-wide waste management systems is gaining visibility. The reason according to Prochatzki et al

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(2023) is that a circular economy, compared to a linear economy, is resource efficient and helps to achieve sustainability goals.

Jonathan (2023) found that growth in any sector of the economy drives high demand for and excessive extraction of raw materials leading to scarcity. For Rizvi et al. (2023) and Flor et al. (2025) CE emerges as the most viable option to the challenge of scarcity of resources threatening the sustainability of human lives in the future. Likewise, Avdiushchenko and Meinrenken (2025) argue that CE is one way of reducing over extraction of natural resources and associated land degradation. This is because CE offers the needed integration between sustainability and business development (Ritzén and Sandström, 2017). A shift from an unsustainable use and throwaway linear economy, which Di Maio and Rem (2015) and Modic et al. (2025) call a take-make-dispose model or a “take-make-waste” model (Sehgal et al, 2025) relying heavily on easily accessible resources, is therefore inevitable through CE (Lazarevic and Valve, 2017) in response to the predicted scarcity of non-renewable natural resources.

Shabani et al. (2023) attribute the rise in global solid waste accumulation to anthropogenic activities while Hernandez and Bakthavatchalam (2022) and Esteva et al. (2020) boldly state that the automotive industry will significantly contribute to the global environmental crisis because of its predicted substantial growth in the coming decades which according to Rizvi et al. (2023) will worsen the menace of solid waste accumulation Najar et al. (2024), already claim that waste accumulation is an escalating global problem with adverse effects such as climate change, environmental deterioration, and negative impacts on human health. Due to escalating volumes of waste and the worldwide shift towards recycling, the waste management sector is transforming into an independent and vibrant manufacturing industry (Viswanathan and Telukdarie, 2022) and this requires a re-examination of the whole chain of waste generation activities (Nuralievna and Park, 2023 and Saidani et al., 2018). Accordingly, the transition towards a circular economy has triggered global reconfiguration of economic activities in search of green alternatives. Per Kankanamge et al. (2025) transitioning to CE is accompanied by tensions stemming from the “paradoxical nature of achieving circularity.” Circularity therefore necessitates evaluating the feasibility of its application and adopting a targeted approach that prioritizes strategic sectors (Mansuino et al., 2024). Compared to a linear economy, a CE provides a range of strategies to diminish the consumption and demand for dwindling natural resources, along with supplementary secondary advantages that contribute to the attainment of financial and sustainability objectives (Nogueira et al., 2025; Modic et al. 2025; Prochatzki et al., 2023). Nonetheless, as demonstrated by Kirchherr et al. (2017), there is no uniform understanding of the CE concept.

2. Statement of the Problem

Zimbabwe, like many other African countries, faces significant challenges regarding the management of solid automotive waste. Prior studies by scholars such as Shabani et al. (2023), Chikowore (2021), Mandeverere and Jerie (2018), Tongesai et al. (2018) reveal that waste management practices in Zimbabwe focus mainly on the negative implications of waste accumulation in areas outside the automotive sector. Again, there is no specific automotive waste management policy for the automotive sector apart from the blanket and broad provisions of the Environmental Management Act Chapter 20:07. Even with this law, the inflow and accumulation of used auto mobiles in what resembles an ‘export to dump’ pattern, continues. A recent policy ban on vehicles older than 10 years (SI 54 of 2024) has not helped. Furthermore, there are no specific, publicly reported statistics on the quantum of end of life vehicle waste that keeps piling in Zimbabwe, a scenario that makes it difficult to develop policies or strategies for addressing the problem. This is compounded by waste comprising accident-damaged cars, non-runner vehicles, and vehicles parked in garages for extended periods due to the unavailability of spare parts and pending repairs. The mushrooming of car breaking sites for avoidance of the term car dumpsites for end of life (EoL) vehicles is evidence of the increasing automotive waste problem. This reality is confirmed by Hernandez and Bakthavatchalam (2022:1) who argue that because of the largely linear economy model, once a vehicle reaches its EoL, many of the components of the car end up in landfills and over 6.9 million tons of automotive waste in the European Union (EU) alone were recorded by 2019. Ragonnaud (2023:1) also writes that the EU had by that time 286 million motor vehicles on the road and about 6.5 million become waste each year representing millions of tons of lost materials. For Sardo et al. (2025), conventional landfills are unsustainable hence CE is a viable solution.

The accumulation of automotive waste has both positive and negative effects on developing country economies. Regardless of the positives, there is no significant scholarly research on CE ideas in the automotive sector in Zimbabwe. Even studies on general waste management are rare as acknowledged by Shabani et al. (2023). Additionally, waste management ideas are at nascent stages. Scanned literature for example Shabani et al. (2023), Chikowore (2021), Mandevera and Jerie (2018), Tongesai et al. (2018) and Agyemang et al. (2019) acknowledges that in Zimbabwe and other developing countries, waste management strategies are still rudimentary and choked by confrontational and static legal frameworks, poor planning, lack of resources and expertise in advanced waste management methods. Current waste management strategies do not perceive much economic value from solid waste in Zimbabwe (Shabani et al, 2023) but instead contradict aspirations enshrined in sustainable development goal 12 as well as goals 3; 6; 8; 11; 13 and 15. Even so, Ritzén and Sandström (2017) argue that CE is little implemented in practice. This is not farfetched given that Esteva et al. (2020) also argue that no comprehensive CE model exists for the automotive sector. This study is therefore novel and different in that it focuses specifically on the management of automotive waste in Zimbabwe. The study stimulates the need for further research and action on managing automotive waste within the context of a CE model.

A sustainable CE model in the automotive waste can create job opportunities, stimulate the growth of downstream industries, and contribute to climate change mitigation efforts. This can generate substantial economic value but the issue of circularity in this regard is neglected in Zimbabwe. Di Maio and Rem (2015), stress that there is an urgent need for a transition to CE to mitigate resource depletion and environmental degradation. This further helps the country to exploit fresh business opportunities beneficial to society and the environment, and promote resource sustainability. Using this framing of CE, Flor et al. (2025) view CE as part of a major sustainability discourse though its application faces challenges including isolated implementation activities and hindrances to systematic change. In summary, the problem is that Zimbabwe has no CE model for the automotive sector and this lack of a CE model results in massive accumulation of automotive waste from end of life vehicles.

3. Research Objective and Contribution

The main objective is to develop a CE model for managing automotive waste in Zimbabwe. This article aims to bridge the gap in knowledge, confirmed by Flor et al. (2025) that a significant gap exists between CE implementation and CE model development. There is also a dearth in knowledge how perceived models can support a green automotive sector. This study further addresses the problem that the current emphasis on recycling does not fully capture the economic and environmental benefits of circularity. Additionally, this article packages in one compartment, prominent CE ideas and benefits that policy makers in Zimbabwe can learn from. This study focuses on EoL automotive waste and not on other aspects such as general health implications of poor waste management on Zimbabwe. These aspects are adequately covered by Shabani et al. (2023), Mangizvo and Chinamasa (2008), Zubar and Andrees (2019), Chatira-Muchopa (2019), Mangizvo, (2010), and Shabani and Jerie (2023). The study however maintains that adopting a robust CE model can address these challenges by creating a better balance and harmony between the economy, society and the environment (Nuralievna and Park, 2023). As CE ideas gain global acceptance, this article becomes important as it adds clarity on how the shift to a CE model can be optimally achieved in Zimbabwe. The niche discussion is the application of CE ideas in the automotive sector drawing from global circular best practices adopted in other regions. The key research question therefore is: What is the best model for dealing with solid automotive waste accumulation in Zimbabwe? This paper answers this question by providing conceptual lucidity to CE and its implications for policy precision in Zimbabwe. The remaining segments of this article, designed to provide answers to this question, are spread over the conceptual framework, the research methodology, the literature review, the discussion of results and the conclusion.

4. Materials and Methods

This study adopted a qualitative research and a systems thinking approach. This approach was adopted because it provided researchers with a holistic understanding of the complex connections between CE, economic,

environmental and social factors. This approach further assisted in understanding CE goals, stakeholders in the automotive waste management sector as well as the benefits and implementation challenges confronting CE. Ultimately, this informed the design of the proposed model. Accordingly, the first phase involved an extensive review of relevant literature, including academic articles, reports, and policy documents. An exclusion/inclusion search string of key words including the words ‘circular economy ideas’ such as ‘automotive waste’, ‘automotive waste Zimbabwe’, ‘automotive waste Africa’, ‘automobile industry waste’, ‘automotive solid waste management’, ‘recycling, reuse, refurbishment’ and ‘sustainable development’ was used, as the inclusion criteria, to obtain publications from Scopus, Web of Science, Google scholar, and videos from YouTube. In addition, only articles written in English were selected for inclusion. This systematic approach allowed the author to filter and identify relevant literature based the titles and analysis of abstracts as recommended by Nuralievna and Park (2023) and Prochatzki et al. (2023) who suggest that this helps to exclude those publications that do not meet the inclusion criteria where it is defined. This approach meant that publications mentioning CE but not dealing with automotive waste were not considered important but useful in explaining the concept of circularity. In addition, only peer reviewed articles were selected for analysis in this study. The steps taken to select a sample of articles that were included in the study is summarized in the following methodological flow diagram:

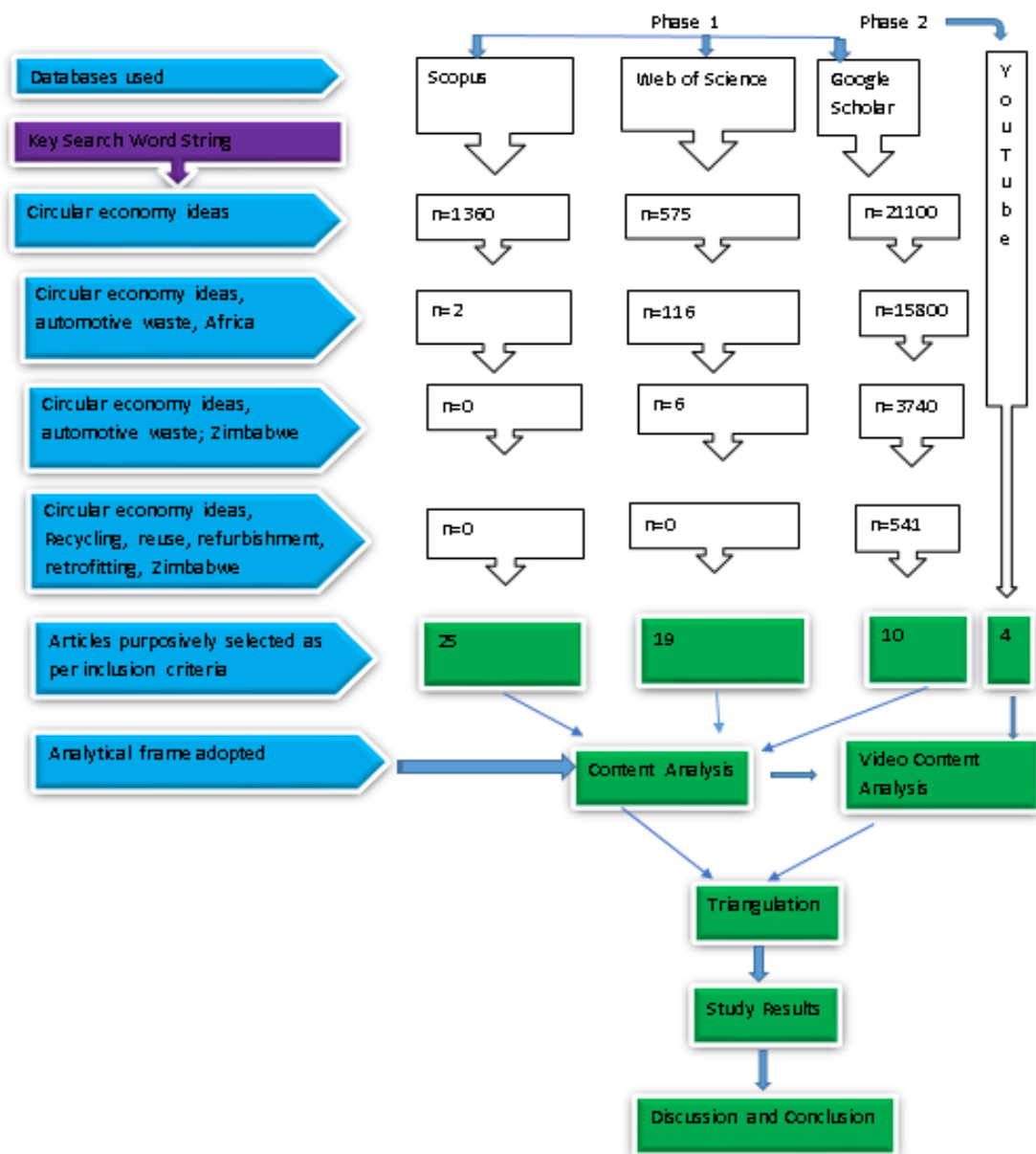


Figure 1. Methodological Flow Diagram (Source: Research Author (2025))

The steps summarised in the methodological flow diagram produced 54 articles and 4 videos that were purposively selected for this study. Figure 1 clearly shows that peer reviewed literature on Zimbabwe is very limited. A key search word string with the word Zimbabwe returned nil results on the SCOPUS Database and only 6 results on the Web of Science Database. The outlier results on Google scholar clearly included some material that is not peer reviewed and that was rejected and not included. However, the search strategy for videos was different and purposively targeted at specific automotive sector CE videos. A full text analysis of selected publications was then done. In analysing the selected publications, researchers used content and thematic analysis focusing on definitions of CE, requirements for CE, CE principles, CE benefits, and challenges affecting CE implementation. Collected data was then used to develop components of the model that include sources of vehicles and vehicle waste, requirements for effective waste managements, waste classification, viable CE approaches, waste recovery, and feedback, policy and legal requirements. Publications that were selected but not accessible were automatically excluded. Biographies from identified relevant publications were also used to identify additional useful literature. This review, done through content analysis, provided a comprehensive understanding of circular economy models, automotive waste management practices, and the potential for a green automotive sector. The data obtained informed the subsequent phases of the research. The second phase involved data collection through video content analysis (VCA). To identify videos, researchers adopted the same search strings used to identify scholarly articles. This method helped in identifying videos on circular economy ideas for the automotive sector on YouTube. The use of VCA allowed the researchers to follow through visual narratives. Because videos proved to convey complex information, researchers found them to be a rich source of data. This allowed researchers to identify patterns, themes and meanings related to circularity which assisted researchers to identify the key requirements for a viable CE model for Zimbabwe. No previous study was found to have used this methodology before and caution was exercised. Even so, the methodology was found to be suitable for a study of this nature because it permitted triangulation of results from content analysis and video content analysis thereby providing useful conclusions. These data sources provided a comprehensive understanding of circular economy ideas for the automotive industry and to avoid over saturation, related ideas were consolidated to produce views presented in the following segments.

5. Literature Review

This segment paints a concrete picture of the extent to which CE principles have been adopted and implemented by developing and developed countries. The potential for CE in the automotive industry sector and its potential obstructions, both real and imagined, were examined. This formed the basis for the proposed model for Zimbabwe. This section begins by providing the conceptual definition of CE, traces CE enabling frameworks developed by other countries, explores the empirical promises of CE ideas, impediments to CE implementation and the current automotive sector policy framework in Zimbabwe.

5.1. Conceptual Insights on Circular Economy Ideas

Generally, CE is an emerging concept with notable conceptual fuzziness (Modic et al., 2025). CE has been variously defined in literature but the idea behind CE has existed for a long time (Avdiushchenko and Meinrenken, 2025). Mignacca et al. (2025: 2) define CE theory as “a set of concepts and their interrelationships”. Referencing previous works by Skene (2017) and Korhonen et al. (2018), Kirchherr et al. (2018) and de Jesus and Mendonça (2018) note that CE is a contested concept that, since the 1960s, has continued to be refined. Scholarly interest continues to grow exponentially and many writers provide their useful conceptualizations of the concept. Using the South African agro-industry context, Wolfaardt et al. (2025) defines CE as a resilient economic system aimed to promote sustainable development. Learning from Mehmood et al. (2025), CE is a model of production that involves sharing, leasing, refurbishing, and recycling materials and products. For Esteva et al. (2020) circularity is a model with three phases which are the materials and manufacturing circularity phase, use-phase circularity and the end of life circularity phase. This classification aids our understanding of the end to end CE process. According to Agmeyer et al. (2019:3) CE refers to the transitioning of business operations from the traditional linear economic system to a circular system where damage done in resources acquisition is restored. Ritzén and Sandström (2017) suggest that CE

is a concept that involves keeping materials available instead of disposing them. This, they argue, closes the loop of materials within the product lifecycle, in order to reduce resource usage and energy demand. Likewise, Nuralievna and Park (2023), write that CE is a closed loop system that seeks to increase the efficiency of resource use. The study by Ritzén and Sandström (2017) concludes that CE is coping with three challenges namely resource scarcity, environmental impact and simultaneously increasing economic benefits.

A synthesis of 114 definitions by Kirchherr et al. (2017) reveals the following three key aspects of CE: 1. That CE is a closed loop system of production of goods that largely depends on material resource flows from waste, 2. That CE is a system that depends on recycling, limiting and reusing waste as an input resource reducing primary resource consumption. 3. It is therefore a system that alleviates the scarcity of resources, reduces environmental pollution and induces a digital culture in the automotive sector. Another widely accepted definition of CE is that it is “an industrial system that is restorative or regenerative by intention and design” (Hernandez and Bakthavatchalam, 2022:1). According to Montemayor and Chand (2023), a CE model focuses on the economy and the environment and its benefits over the linear system. It is therefore a framework through which aspects of sustainability are achievable (Lazarevic and Valve, 2017). More recently, Flor et al. (2025) uses the idea of “positive tipping points” to explain CE and note that CE is a process that creates better socio-ecological conditions. Yosthongngam et al. (2025) agree that CE addresses concerns over climate change, ecological degradation, and unsustainable resource consumption. This aligns with the argument of Kankanamge et al. (2025) that CE reduces greater demand on finite natural resources.

What emerges from these definitions is that CE has obvious links with sustainable development hence the boundless enthusiasm among scholars and practitioners. It also flows from the definitions that CE is a multi-actor concept as underscored by Kirchherr et al. (2018). Hernandez and Bakthavatchalam (2022) in their discussion of a gamut of factors that must be overcome to accelerate transition to a CE, make specific reference to demand creation through collaboration, early engagement and stakeholder engagement as a fundamental requirement for transition to CE. This agrees with the view by Ritzén and Sandström (2017) that CE is a business model that triggers change that fundamentally runs through the whole organization and therefore calls for a multi-stakeholder approach. Per Jonathan (2023) stakeholders carry the responsibility for advancing circularity. Muzamwese et al. (2024) equally affirms that multiple stakeholder partnerships are required to attain a CE. This is consistent with the argument of Tanveer et al. (2025) that public-private partnerships (PPPs) offer strategic alignment that facilitates CE initiatives. Modic et al. (2025:2) further support the view that “CE requires involvement of various actors with a broad spectrum of interests.” However, the definitional diversity per Wolfaardt et al. (2025) reflects a persistent lack of agreement on the topic. Notwithstanding Wolfaardt and others’ argument, a purification of definitions above produces a working definition. CE is therefore a concept which by design and intention is a multi-stakeholder sustainability-driven economic or business logic model based on a use and reuse mind-set and culture that seeks to extend the life of products in line with set quality standards in order to minimize resources and energy consumption and ultimately reducing damage to the environment.

5.2. Circular Economy Enabling Frameworks, Policy Requirements and Principles.

The automotive industry sector is forecast to become a gigantic industry with stratospheric input resource requirements and a driving force among many industries in India and other countries (Rizvi et al., 2023). This has forced sustainable development and green economy activists to demand innovative green technologies and creative policy interventions across the globe. Without a doubt, CE execution in the automotive sector under the banner of a green culture demands that enabling factors be identified. According to Govindan and Hasanagic (2018), drivers of CE initiatives are split between internal environment and external environment categories though different scholars use different clusters to differentiate them. Ritzén and Sandström (2017) argue that CE implementation demands new enabling structures and procedures like any new model. This, according Kankanamge et al. (2025) necessitates increased focus and commitment to facilitate the transition from traditional linear economic models. In the Indian context, enabling factors that significantly influence CE execution, that must be incorporated in CE models depending on country circumstances, were found to include Internet of Things (IoT) asset sharing, going digital, use of intelligent devices to support CE, green financing, waste stream analysis and perceptions of manufacturers (Rizvi et al., 2023). The sum total of the above arguments is that CE is an end to end process and enablers of CE are located in both the internal and

external environment of an organization. It is submitted here that for effective CE, constructing a new model where there is none, is a prerequisite for success.

Policies, laws and regulations are prominent drivers and enablers of CE. European and Asian countries, including Germany, Japan, the Netherlands and China, have enacted laws and promoted policies to support CE. The EU developed its supranational framework, the Circular Economy Package 2015/2018 (Kirchherr et al., 2018) which most countries mimicked. As per Prochatzki et al. (2023), Germany pioneered its CE framework under the Closed Substance Cycle and Waste Management Act in 1996 which was followed by the European Union Circular Economy Action Plan (2015, 2020) (Hernandez and Bakthavatchalam, 2022). By 2023, debate on new regulations and laws to advance circularity and position the EU as the most resource efficient continent was initiated (Ragonnaud, 2023). Japan also adopted the Circular Economy Vision 2020 through the Ministry of Economy and Trade and Industry and China followed suit by adopting the Circular Economy Promotion Law in 2009. The influence of these policies is substantial. Montemayor and Chand (2023) suggest that policies in these countries shape CE activities in other regions. According to Di Maio and Rem (2015), proper legislation with financial incentives stimulates recycling. Similarly, Nuralievna and Park (2023) agree that policies with an incentive component promote CE. This fits well with the argument of Hernandez and Bakthavatchalam (2022) that transition to CE requires policy incentives. Clearly, countries that have succeeded to date have invested in developing supportive CE policies, laws and regulations. Without exception, countries such as Zimbabwe require up-to-date laws and regulations designed specifically for stimulating and supporting CE thinking and adoption. This directs attention to the need to formulate laws and regulations that create CE structures that turn the automotive waste sector into a vibrant productive sector (Prochatzki et al., 2023) with clear standards that can trigger innovation. The argument therefore is that long term innovative and supportive CE policies are a prerequisite for sustainable CE.

In today's sustainability driven society, CE has emerged as a guiding principle for responsible resource use (Patriarchi, et al., 2025). Thus CE principles must be understood with clarity for CE to succeed. According to Ritzén and Sandström (2017), sustainable development requires that disruptive changes and radical innovations be aligned to CE principles. These CE principles aim to minimize waste accumulation and energy consumption while promoting local production. The basic CE principle connotes the need to produce and use products and their components as extensively as possible (Prochatzki et al., 2023). Di Maio and Rem (2015) agree that reclaiming as much as possible material value through effective recycling is a crucial principle for an effective CE model. By extension, this means that products should be designed to be functional and durable with potential for repairing and refurbishing, reusing and recycling. It follows that the need to extend the service life of a product beyond its life is a key CE principle. For this to be achieved, CE dictates that there be changes in the design and manufacturing processes to align them with sustainable CE ideas. The changes have to be made at the materials manufacturing stage where important decisions about sourcing of materials, design and durability of products, and other logistics choices are made (Esteva et al., 2020). Similarly, Ritzén and Sandström (2017) also argue that this can be achieved using the four R-strategies: repair, reuse, recondition and recycle. Flor et al. (2025) also add reduce, refurbish, remanufacture, re-purpose, recover energy and re-mine on the list of R-strategies. Per Prochatzki et al. (2023) these principles mean that the end to end manufacture of products aims to reduce the use of natural resources and promote designs that prefer durability to allow easy reparability and reprocessing. Under these principles, the reuse or further use of a product beyond its lifespan is the ideal. But where this cannot be realized, down-cycling or recycling to recover reusable materials for another lower level purposes can be pursued (Prochatzki et al., 2023). In the Indian context, reuse was found to be the most appropriate CE strategy (Rizvi et al., 2023). CE goals can therefore best be achieved within the context of these CE principles. Accordingly, the model presented in Figure 1 clearly suggests that after waste classification, a viable CE approach should be selected. Implied is that an approach that has potential to produce outstanding CE results should be selected. This could also be simultaneously implemented with other approaches for high impact CE to be achieved as explained in the following paragraphs.

The core principles of CE are a series of resource-recovery processes, commonly known as the "R" principles. These are refuse, redesign, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, rethread, rebuying, and recycle (up and down) (Yeh and Yang, 2024; Prochatzki et al., 2023; Esteva et al. 2020; Jonathan, 2023). According to Rizvi et al. (2023), CE aids waste management by allowing resources to be continuously circulated through recycling, reusing, and remanufacturing. These principles can be categorized into four levels (Montemayor and Chanda, 2023). Level 1 includes reusing, refurbishing, and repairing; Level 2 focuses on remanufacturing and repurposing; Level 3 involves recycling, composting, and anaerobic digestion; and Level 4 addresses waste management and recovery. In the automotive industry, major European

brands are already targeting recycling, reuse, and remanufacturing to achieve circularity (Hernandez and Bakthavatchalam, 2022).

While product modification or retrofitting may be part of redesign, it could be considered a standalone strategy. This would allow for the creation of electric vehicle (EV) components that can replace gasoline engine parts in older vehicles, keeping the original body intact. This aligns with the argument of Montemayor and Chanda (2023) that the automotive industry is undergoing a monumental shift from internal combustion engines to EVs, in order to combat environmental degradation and climate change. This shift has a long-term impact on waste reduction and creates economic value through new downstream industries, such as battery manufacturing, auto-electrics, panel beating, and upholstery. However, the authors point out a critical gap, that while there is a strong focus on reducing emissions, there is less attention on managing the accumulation of vehicle waste from both internal combustion engines and EVs at their end of life. It is submitted here that a sustainable CE model must address this issue.

For these CE “R” strategies to succeed, a comprehensive framework is needed (Martins et al., 2022). This framework must incorporate sustainability principles that include, 1) designing for a circular economy, 2) building circular supply chains, 3) improving environmental performance, 4) extending resource and asset life-cycles, 5) utilizing regenerative and renewable resources, 6) turning waste into new resources, and 7) adopting digitization and other technologies. The proposed model in this paper incorporates these sustainability principles.

5.3. Empirical Promises, Successes and Perils of Circular Economy Ideas

CE ideas are credited for complimenting sustainable development agendas. CE promises are generally linked to solving resource scarcity and depletion, environmental degradation, price increases, waste management, rising demand for energy and pollutant emission problems (Agmeyer et al., 2019; Prochatzki et al., 2023; Ritzén and Sandström, 2017; Yeh and Yang, 2024). Citing the European Commission (2015), Yeh and Yang (2024) affirm that a CE approach is a promising means to reduce global sustainability pressures. Added to that, Jonathan (2023) stresses that CE offers economic, environmental, and social benefits. Another broad claim supported by evidence from Saud Arabia is that CE unlocks economic opportunities, preserves natural resources, and improves environmental performance (Martins et al., 2022). If circular economy ideas can be implemented, there is general consensus among scholars that sustainability and profitability can be achieved (Prochatzki et al., 2023, Esteva et al., 2020; Hernandez and Bakthavatchalam, 2022 and Bauer et al., 2020). In fact, Oktrivina et al. (2025) agrees that CE practices improve financial performance both directly and indirectly. Circularity enhances closed loop value and supply chains, circular business models, circular product design and more specific to the automotive industry, end-of- life (EoL) management. In line with these views, Prochatzki et al. (2023) concluded that implementing CE principles provide effective methods for enhancing sustainability in both production and consumption. If this is not done, Jonathan (2023) cautions that by 2050, materials consumption demand in Africa and Asia will be unprecedented due to increases in population size. Advanced CE approaches are therefore seen as a viable solution unavoidable in the future.

Learning from Prochatzki et al. (2023), implementing CE strategies can significantly contribute to achieving several UN Sustainable Development Goals, particularly those related to resource efficiency and environmental sustainability. Additionally, strategies such as reduce, reuse, and remanufacture are recognized as having greater potential for sustainability compared to traditional recycling methods. Di Maio and Rem (2015) add that CE possesses potential to create greater economic value through efficient use of resources. Evidence from Kenya shows that CE ideas are viable for the construction sector but ethical concerns must be overcome when CE leads to treating Sub Saharan Africa as a dumping site of end of life products (Jonathan, 2023). Likewise, Martins et al. (2022) found that the rubblization of the concrete pavement for Shaybah Airport Runway Project in Saudi Arabia, as a CE initiative, was a success. This project achieved zero environmental waste and material disposal, maximized product efficiencies and life cycles, shifted energy sources to renewable sources and reduced the cost and completion time for the project.

Zavala (2025) also found that CE ideas resulted in sustainable battery waste management. Sustainability was also achieved in the upcycling of plastic waste into sustainable composite materials for 3d printing and injection molding. According to Saini et al. (2025), this resulted in significant advancement in sustainable polymer processing. In Sri Lanka, Kankanamge et al. (2025) confirm the shift towards circular e-waste management to address the rapid accumulation of end of life e-waste. Likewise, Sehgal et al. (2025) claim that

transitioning to CE to combat the challenge of e-waste generation in the electronics sector is a strategic move. CE principles have also been successfully applied in waste to energy projects in Europe resulting in massive reduction in waste accumulation (Yosthongngam et al., 2025). The same model has been adopted by Geo-Pomona in Zimbabwe where waste collection has significantly improved resulting in substantial clearance of waste dumps in residential areas. In food production, Ferreira-Garcia et al. (2025) also found that the UN Sustainable Development Goals around food security can best be met through a transition from a linear to a circular economic model for agricultural production centered on converting waste into valuable resources. Likewise, Wolfaardt et al. (2025) found that CE can help agrifood industries and address their economic, environmental and social sustainability challenges.

Related to the present discussion is that CE principles were found to be effective in upcycling, focusing on poly (vinyl butyral) (PVB), widely used as an interlayer in laminated glass, recovered from automotive waste via a patented mechanochemical process (Patriarchi et al., 2025). In the management of end of live vehicles (ELVs), Aggrawal, Das and Kalbar (2025) found that CE principles result in sustainable resource use and minimize negative environmental impacts. Ncube et al. (2020) also agree that a CE model has a positive impact on the brick making industry in Zimbabwe which is known to have detrimental impact on the environment. Prochatzki et al. (2023) however concluded that more sustainable CE approaches are neglected despite their known potential. This aligns with the argument of Jonathan (2023) who notes that CE concepts are not household norms in African households due to lack of awareness. Beyond these arguments, CE has quantifiable time and cost savings for the economy and reduces environmental damage when adopted.

Yosthongngam et al. (2025) and Di Maio and Rem (2015) found that the transition to CE can decouple economic growth from resource consumption in the EU. Relatedly, Kirchherr et al. (2018) and Saidani et al. (2018) estimate that the EU will benefit from cost savings running into trillions by 2030. Again, shifting to circular business models can create more jobs and enhance resource efficiency, addressing both economic and environmental challenges. In fact, the job creation potential of a CE model is estimated to exceed, according to Kirchherr et al. (2018) two million jobs by 2030 for the EU alone. Jonathan (2023) identified similar potential for CE driven job creation in Kenya. All in all, these scholars agree that a CE model therefore aligns with broader national and global policy goals. These policy goals include creating more value per unit of resource, reducing carbon footprints, encouraging recycling, job creation and greenhouse gas reduction, enhancing environmental outcomes, and fostering innovation which are key considerations for both developed and developing countries. According to Di Maio and Rem (2015), another benefit of a CE approach is reduced risk of supply chain disruptions, reduced price volatility and reduced strategic resource dependencies (Ragonnaud, 2023). The same literature suggests that anticipated increases in the tonnage of waste are also expected to drive further innovation in boundary pushing technologies capable of handling large quantities of waste as well as optimizing recycling up and down. Notwithstanding the above promises of circular economy ideas, dealing with automotive waste remains complex. Per Montemayor and Chanda (2023), the use of composite plastics which are harder to separate and recycle compared to metal presents severe complicatedness to the success of CE ideas. Again, Jonathan (2023) found that increased carbon emissions remain a great ally of CE recycling activities and this imposes exogenous effects on other economic sectors such as agriculture. In the same literature, CE was also found to pose significant threats to the existing market of importers of materials thereby creating a serious conflict of interest. Clearly, CE ideas do not completely eliminate environmental risks and may have seismic impact on other economic sectors.

5.4. Potential Impediments to the Implementation of Circular Economy Ideas

Barriers to CE implementation have received high level scholarly attention. de Jesus and Mendonça (2018) write that progress towards CE is not without complications and call it a boom versus doom scenario. Kirchherr et al. (2018) identify these barriers as “soft” and “hard” barriers from their analysis of eleven (11) specific publications on this subject at the time. Their study identifies four main categories of factors that derail CE which are cultural, regulatory, market and technological barriers with no restriction on identifying additional sub-barriers. Agmeyang et al. (2019) also identify eight (8) significant studies that provide vast evidence of several barriers to CE. Relatedly, Ritzén and Sandström (2017) state that barriers to CE can be financial, structural, attitudinal and technological. It is evident that barriers to CE are well traced in literature. Understanding these barriers and their sub-barriers is arguably important as it helps policy makers and

practitioners to develop targeted interventions that can fix implementation predicaments and drive successful CE implementation. This calls for further intense analysis of the multiple possible interaction effects among these barriers which, according to Kirchherr et al. (2018), can create a chain reaction leading to CE failures that can perpetuate the linear economy.

The major impediment to the implementation of CE ideas that emerges is lack of appropriate and proven technologies. Technology infrastructure, as reported by Mehmood et al. (2025), is a CE readiness requirement. On this barrier, which Ritzén and Sandström (2017) classify as operational, limited infrastructure and supply chains are identified as impediments that must be resolved. Agrawal, Das and Kalbar (2025) also add that the adoption of advanced technologies such as material tracking and efficient de-pollution systems is a prerequisite for successful CE. However, the lack of advanced waste management infrastructure and technology in Zimbabwe is obvious. This was also found to be the case in Indonesia (Bui et al. 2025). Implementing CE under the shadow of 4IR demands robust technology and inclusion of new technology ideas to handle automotive waste as a prerequisite. For Ritzén and Sandström (2017), the lack of technologies that can handle product design and integration into production processes impedes CE. CE concepts have an inbuilt quality assurance component especially in the waste recycled products, hence enormous scope for 4IR interventions demanding sophisticated technologies (Viswanathan and Telukdarie, 2022). This requirement has not been met in developing countries. Admittedly, this 4IR-CE nexus is however little explored hence there is limited knowledge on the intersection of the two (Rizvi et al., 2023). If these technical barriers can be overcome, Preston (2012) argues that CE can unlock a wide array of opportunities. Developed countries however do not find this as a barrier because they have the technology in place. Per Di Maio and Rem (2015), the presence of advanced waste management infrastructure in developed countries allows a complete collection of solid waste. For countries like Zimbabwe, Shabani et al. (2023) note that reliance on traditional linear waste management approaches is no longer sustainable hence the urgent need to evaluate solid waste management options available. The collect and dispose model, referred to as the classical model of 'take, make, and dispose' (TMD) (Rizvi et al., 2023) or the 'take-make-consume-throw away' (Nuralievna and Park, 2023) or the 'extract-produce-dispose trajectory' (Yosthongngam et al., 2025) is not feasible for the automotive sector in Zimbabwe. There is therefore an urgent need to adopt superior technologies and develop a sustainable waste management model for the automotive sector in Zimbabwe for CE to be a success.

The cultural posture of both society and organizations in a country greatly influences CE implementation. Ritzén and Sandström (2017) place this factor under attitudinal factors. Under this category, their study identifies perception of sustainability and risk aversion as key blockades to CE implementation. Referring to sub-barriers under culture, Prochatzki et al. (2023) underline that key challenges include quality issues, insufficient political guidelines, and a lack of awareness regarding the long-term economic benefits of CE. Accordingly, they recommend the need for stronger political frameworks and consumer behaviour changes to facilitate the adoption of CE practices in the automotive sector. Similarly, Sardo et al. (2025) point out that concerns over quality are a barrier to CE implementation. While it is argued that the European Union block of countries has failed to realize the benefits of CE in full due to technological barriers, Kirchherr et al. (2018) rebut this argument and blame cultural barriers as major impediments to CE implementation. Their study found that two core cultural blockades to CE implementation are lack of consumer interest and awareness and a hesitant company culture, here after organizational culture. This rebuts the argument that CE is widely embraced by companies.

According to Ritzén and Sandström (2017), to become part of sustainable development, organizations must possess the capacity to manage innovation and overcome the complexity of integrating sustainability in existing economic or business models. However, these scholars concede that questioning an organization's underlying business model is the hardest thing to do. For Hernandez and Bakthavatchalam (2022) this equates to challenging the current system and can best happen when boosting the shift to CE. Notwithstanding this limitation, this paper advances the argument that this actually creates the need to learn and unlearn new requirements for CE and understand deep rooted and dominating linear economy models and ideas to facilitate transition to CE.

With regard to consumer culture, the major hindrance is that consumers prefer new products and where this is the case, CE implementation stalls. Flor et al. (2025) confirm that circular products can be perceived as low quality and this mind-set must be changed for CE to succeed. On the other hand, when a company's vision, mission, goals, strategy and key performance indicators do not reflect a CE inclination, it clearly shows that companies have not yet mainstreamed the CE concept. Relatedly, Muparadzi et al. (2024) mention that culture must be infused with any technology adoption strategy. Borrowing from that argument, a culture readiness is

a crucial requirement for the success of CE implementation. In this instance, the waste culture according to Hernandez and Bakthavatchalam (2022) is a roadblock that must be removed.

Established supply chains based on the linear economy model barricade CE implementation. Ritzén and Sandström (2017) argue that implementing CE is a whole of country or whole of organization initiative that creates changes that cut across the status quo, and introduces a disruptive transition process in which current ways of doing things have to change. What this means is that there is a need to understand the implications of dismantling these established supply chains. This is because those with political influence are invested in primary resources extraction and would obviously demonstrate an obvious slow and risk averse approach and inertia (de Jesus and Mendonça, 2018) towards CE implementation or what Pheifer (2017) identified as a “no sense of urgency” approach. Ritzén and Sandström (2017) extend their argument by stating that it is almost only when risk is taken that a new level of newness is achieved. Therefore, understanding key cultural elements such as hesitant organizational culture in general and more specifically in the automotive sector, willingness to collaborate and citizen awareness and interest as per Kirchherr et al. (2018) and Modic et al. (2025) would substantially redefine CE implementation in Zimbabwe where culture has not been found to exhibit hostility towards technological interventions.

Flor et al. (2025) found CE awareness to be a crucial enabling condition. Likewise, Maqsood et al. (2025), though investigating CE in the corn waste sector, found that substantial awareness-raising among all the actors, in this case actors in the automotive sector, is crucial. Prochatzki et al. (2023) also found that the different ways in which the term CE is understood potentially causes its implementation to fail. Similarly, Kumar et al. (2019) and Muzamwe et al (2024) write that both lack of proper training and awareness and the lack of understanding of CE principles are major barriers to its implementation. In Pakistan, lack of awareness or what Agyemang et al. (2019) calls unawareness ranked as the most significant barrier to CE. On the contrary, countries like China and EU countries lead in producing research on CE hence they have advanced knowledge about the concept compared to developing countries (Nuralievna and Park,2023). These arguments mirror what Ritzén and Sandström (2017) classify as structural challenges especially where there is evidence of a missing exchange of information resulting in lack of a shared understanding of CE. More specifically their study found that there is a shallow understanding of and insight into CE. Though this article found this to be the case especially with notable variations in definitions adopted by different sectors based on the nature of waste to be handled by proposed CE interventions, Kirchherr et al. (2018) did not find this to be the case among EU countries. A point of convergence acknowledged in this article is that simplistically, CE is understood the same way as recycling and turning waste into a primary resource for the production of the same product or other products.

However, the extent to which CE principles are understood matters and where there is a naive understanding rather than a nuanced and holistic understanding of CE implementation benefits and challenges, CE suffers. This is the case in most developing countries where a precise understanding of CE should inform appropriate policies and regulations for CE. Such understanding must further catalyse planning and strategic thinking as recommended by Hernandez and Bakthavatchalam (2022). Countries therefore need to invest in learning how a CE business model works in order to develop robust strategies and graft enabling legislative provisions in relevant laws.

Lack of CE implementation models is another notable barrier to CE implementation. Notwithstanding arguments by Shabani et al. (2023), Sassanelli et al. (2019) and Esteva et al. (2020) that the Life Cycle Assessment (LCA) model, developed around the 1970s, enables decision makers to choose appropriate CE compliant waste management approaches, Di Maio and Rem (2015) disagree. Their objection arises from the reasoning that reliance on the LCA and the Materials Flow Accounting and Assessment (MFA) with their known loopholes is a barrier to achieving circularity. The LCA and MFA are considered hard to use to achieve circularity but have achieved positive results in countries such as China, Italy, Singapore and Malaysia (Shabani et al., 2023). However, the search for appropriate models should be continuous because waste disposal strategies in developing countries still occupy the base of the waste management strategies pyramid. Inadequate waste management strategies therefore account for the failure of CE ideas in managing automotive waste.

Kirchherr et al. (2018:268) also identify market barriers as a notable impairment to CE implementation. Their study confirms that ‘low virgin material prices’ and ‘high upfront investment costs’ are the top factors that barricade CE adoption. Esteva et al. (2020) confirm that the benefits of circularity may not always be realized in practice due to cost constraints. Per Ritzén and Sandström (2017), these financial barriers arise from the lack of data on CE profitability. Similarly, Agyemang et al. (2019) found that profitability and other market

related benefits are the top most drivers of CE implying that the lack of data on profitability chokes interest in CE. For Agyemang et al. (2019), cost and financial constraints are the second top most barrier to CE in Pakistan. Market barriers also include lack of funding though this factor was found to be low ranking among EU countries by Kirchherr et al (2018) and Nuralievna and Park (2023). In developing countries for example funding technology adoption was found by Muparadzi et al. (2024) to be a foundational technology readiness requirement. Limited budgets and high costs often create political contestation on the best funding model. As rightly pointed out by Kirchherr et al. (2018), high upfront investment costs may be a symptom of hesitant organizational culture which perceives CE to be too expensive. This finding is relevant in the context of developing countries such as Zimbabwe where CE is a hard-to-implement concept but governments can crack market barriers to tackle problems emanating from drip feeding funding towards CE by introducing legislative amendments designed to scoop a fixed percentage of the national budget and direct it towards funding CE.

Sardo et al. (2025) claim that many countries have policies that support transition to a CE model, yet waste continues to be landfilled. This clearly shows that regulatory gaps as pointed out by Kirchherr et al. (2018) continue to obstruct CE implementation. In fact, Bui et al. (2025) found that lack of regulatory pressure on waste management emerged as one of the major challenges affecting CE implementation in Indonesia. Likewise, Pfeifer (2017) notes that lack of smart regulations and policies that support transition to a CE economy are a pressing barrier that chokes CE implementation. Existing policies and regulations are blamed for obstructing CE in developing countries but this was not a significant barrier in EU countries. Implied is the need for enacting positively framed laws and regulations that spur experimentation with CE ideas and enable CE proliferation by making it a policy priority. This aligns well with the view held by Nyakudya et al. (2022) that sustainable waste management practices, resource efficiency and CE strategies must be mainstreamed in policies to achieve Sustainable Development Goals (SDGs). Introducing targeted interventions and grafting them into existing and future policies and regulations, is desirable for fast tracking transition to and providing momentum for sustainable growth of CE. Again, actions to fill legal gaps are necessary to foster integration and harmonization of action towards CE (Montocchio et al. 2025). Governments can play a key role in the drafting of such policies to end policy hostility towards CE.

5.5. A Brief Automotive Sector Legal and Policy Situation in Zimbabwe

The Zimbabwe automotive sector policy and regulatory ecosystem is a melting pot which includes a policy, laws and regulations summarized below.

5.5.1. *The Zimbabwe Motor Industry Development Policy (2018 -2030)* The main aims of the policy include to promote local assembly and export of motor vehicles, to control used car imports and, to categorize and regulate the motor industry.

5.5.2. *The Road Motor Transport Act (Chapter 13.15)* This Act provides for licensing and registration of motor vehicles as well as for vehicle standards and safety regulations.

5.5.3. *Statutory Instrument (SI) 54 of 2024* This SI regulates the importation of used vehicles and in section 3(1) bans the importation of used cars older than 10 years and burdens the owner of such a car with meeting the costs of exporting the car.

These legal frameworks and policies passively enable transition to CE because there is no provision in the policy and regulations that speaks directly to CE in the automotive sector. This was also found to be the case in Kenya (Jonathan, 2023). Added to that, import dependency poses challenges to CE implementation (Flor et al., 2025). The following model therefore provides a prescription for the treatment of such challenges.

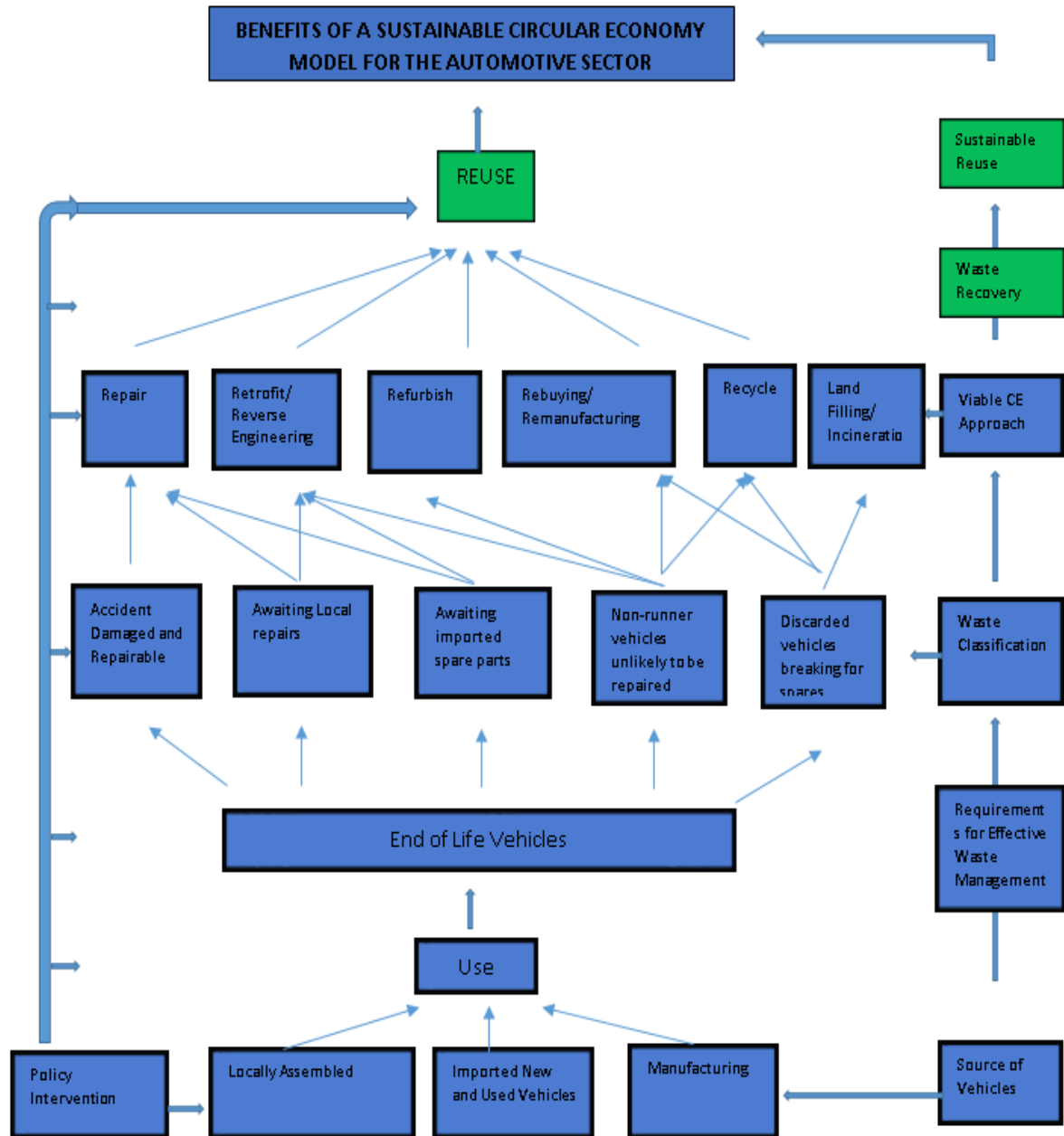


Figure 2. Circular Economy Model and Roadmap for the Automotive Industry Sector in Zimbabwe (Source: Research Author (2025))

The model above was developed based on views from literature and tweaked to suit the Zimbabwean context. As indicated by Maria et al. (2025), a new CE model must address key barriers and issues. In line with that thinking, this model, which builds on existing CE and sustainability strategies, is designed to strengthen resilience of the automotive sector and sustainability of resource supply chains. It shows that the intent of the automotive sector policy must be clear from the onset and should focus on the entire process from assembly, import and manufacturing through to reuse. The model also shows that after reaching end of life, waste management capacity needs must be assessed to determine both demand side and supply side requirements. Thereafter, waste classification should be done in order to identify the appropriate CE strategy that can be used to handle potential waste. These CE strategies can then be implemented to promote reuse and reducing waste to realize sustainable CE benefits already explained in the literature review section. It is also important to note that CE activities shown in the model are scalable. Among the identified CE strategies, rebuying could include developed countries as suppliers or producers buying back EoL vehicles from developing countries to promote

global circularity in the automotive sector. This may result not only in CE but the creation of a vibrant circular global society which promotes the circulation of technology and wealth between rich and poor countries as suggested by Flor et al. (2025).

6. Study Results and Discussion

In line with the methodology used and described above, this paper discusses results from specific authors' angles with some level of harmonization where the stated observations contradict views from other scholars. General patterns were in some cases easy to detect but some views from developed countries expressed in literature clashed with those from developing countries making it difficult to detect what could be part of a good CE model for the automotive sector in Zimbabwe. To overcome this dilemma, prominence was given to views based on empirical evidence from developing countries.

Transition to CE is now a global public administration concern. Despite definitional diversity and tensions associated with transition to CE, available definitions reveal that CE is by design and intention a sustainability-driven economic or business logic model based on a use and reuse mind set and culture that seeks to extend the life of products in order to minimize resources and energy consumption and ultimately reducing damage to the environment. However, the bolts and nuts of CE approaches are still far from being understood with clarity. It follows that an amalgamation of CE knowledge scattered across the globe is paramount for a holistic and nuanced understanding of CE to be helpful in driving CE. Again, a closer comparison of views from literature shows that generally inputs into a CE model for the automotive sector are the same. But even if this is the case, context specific conditions intervene to either support or disrupt CE implementation for example, Zimbabwe lacks sophisticated technology required for successful CE hence variations in CE results are imminent. Policy makers must therefore remain cognisant of these practical realities.

This study also found that policies, regulations, knowledge, culture, technology and funding drive CE but the dominance of the current linearity model was found to be a major stumbling block to the success of CE. Analysed YouTube videos confirmed the need for cutting edge technology, that elevated fixed costs barricade CE and that CE includes strategies such as recycling, reusing, redesigning, and refurbishing. Analysing narratives from videos also revealed that CE is complex. VCA further revealed that literature does not explain in detail as visuals do, how CE involves mammoth ventures requiring a thorough understanding of the framing given to CE by companies and other stakeholders involved. In another video, CE was explained as a way of carefully dealing with resources. More specifically VCA revealed that the recurring themes in CE are sustainable waste management, resource optimization and circular economy practices in the automotive industry. This clearly confirms the widely held views about CE as a resource rationalization mechanism.

Prominent arguments from literature also revealed that factors that affect CE differ depending on the context for example what was found to affect developing countries has very little impact on developed countries in Europe as confirmed by Kirchherr et al (2018) and Nuralievna and Park (2023). Again, findings also revealed that a family of CE strategies include reusing, refurbishing and repairing, remanufacturing, repurposing, recycling, composting, anaerobic digestion, waste management and recovery as well as product modification or conversion or retrofitting (Flor et al. 2025; Yeh and Yang, 2024; Prochatzki et al., 2023; Esteva et al. 2020; Jonathan, 2023; Rizvi et al., 2023). These strategies however require a supporting legal and regulatory ecosystem (Kankanamge et al., 2025) with an inbuilt and committed political leadership support system (Modic et al., 2025). If this is done and if implemented well, CE, though a multi-actor and complex whole-of-country or whole-of-organization initiative, has potential to create a vibrant industry sector. These arguments flowed from the general understanding that the automotive sector has overshooting effects on sustainable environmental management.

Given that generally people are technologically unaware of CE principles and strategies, the study found that this creates a negative and restrictive approach that complicates automotive waste management thereby driving further automotive waste accumulation. These findings are useful in helping policy planners address evolving concerns about automotive waste accumulation in countries such as Zimbabwe and developing sustainable CE strategies. More importantly, findings drive the thinking that while the developed world is working on how to offload used vehicles to third world countries (Rogonnaud, 2023), there is need for forward thinking policy making among developing countries to prevent further dumping of second hand cars in African

countries and reverse the trend through creative modalities for rebuying by developed countries to promote resource circulation and shift toward a global CE model for the automotive sector.

7. Theoretical Contributions

Several theoretical contributions in the context of automotive waste management emerge from this paper. The paper seeks to bridge the knowledge gap in how CE can be implemented. The focus on developing a CE model for the automotive sector is novel as it seeks to address the limitations of current recycling approaches which do not meet the economic and environmental benefits of circularity. This paper also consolidates CE ideas into one framework which makes them accessible and actionable by policy makers. Accordingly, this paper addresses a key problem of the absence of a CE model in Zimbabwe which accounts for the massive accumulation of automotive waste. Within the proposed CE model, countries that are net importers of automobile units can establish a springboard for further research and by drawing lessons from the above findings, countries can strengthen the resilience of resource supply chains for the automotive sector. Finally, the paper stresses that effective waste management capacity is crucial and automotive sector policies must clearly capture their circularity intent.

8. Conclusion

The world is grappling with an aggressive accumulation of automotive waste that has brought CE on the spotlight. CE concepts are an attractive innovative route to achieving sustainable development targets under sustainable development goals and is a sustainability concept that breaks barriers of conventional thinking. CE popularity is undeniably influencing changes towards a sustainable and green automotive sector and that means CE is perceived as possessing significant economic benefits but the availability of leadership, technical and managerial knowledge is a prerequisite for its successful implementation. The indiscriminate disposal of waste, including automotive waste, in all its various forms is common in countries such as Zimbabwe. This confirms the lack of a well-structured automotive waste management approach compliant with CE principles. Notwithstanding this reality, viable and distinct CE strategies are available and what is needed are both incremental and radical innovations in the domain of CE that start with understanding what CE is and transitioning towards CE based on a long term vision and practical application of CE principles. An amalgamation of ideas is also necessary to form a firm basis for experimenting with CE in the automotive sector. This will bring knowledge about required laws and regulations, required technologies, required leadership and political interventions and the required cultural changes. However, it must be underlined, in the final analysis, that there is inevitable tension between linearity and circularity in developing countries such as Zimbabwe which must be negotiated with caution to achieve a smooth shift to a CE model. Overall, a CE model reveals greater good than negative consequences of CE in the automotive sector but the decades of development in this model depict deceptive progress than real progress.

9. Limitations and Scope for Further Research

Future work should adopt a research methodology that incorporates primary data collected from stakeholders in the automotive sector in Zimbabwe. Added to that, a quantitative research methodology may need to be adopted to determine the relationships between factors that influence the shift to circularity in Zimbabwe. Furthermore, a more focused approach that specifically identifies and tests existing models may need to be done to scientifically inform CE adoption in the automotive sector in Zimbabwe. Lastly, a case study approach that focuses on CE strategies used by major automotive companies in Zimbabwe may need to be employed in the future.

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Declarations

Competing Interests The authors declare no competing interests.

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