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Sustainable Waste Management Companies with Innovative Smart Solutions: A Systematic Review and Conceptual Model

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Abstract: Overflowing garbage bins and unnecessary truck visits to collect waste have always been core issues of sustainability and maintaining a green environment. In the recent past, a transition has been observed in waste management towards a better environment and the achievement of sustainability goals. Companies are not only focused on producing less but also transforming waste into energy and reusable products. This transition process needs to evolve through sustainable solutions and innovative marketing initiatives that increase awareness and education among end users. This study used a systematic literature review protocol to identify and review the available research on sustainable waste-management solutions, innovative marketing initiatives, and a proposed conceptual model. It analyzed the latest literature from 1976 to 2022 to assess waste-management trends using the Web of Sciences and Scopus databases. To evaluate the practical perspective, this study analyzed ten waste-management companies offering services in the USA, the UK, Korea, Finland, Ireland, Turkey, Brazil, Slovakia, Portugal, Denmark, and Canada to assess their technological and marketing development for the creation of a better future. It was found that Ecube, Enevo, smart bins, Compology, Bigbelly, Sensoneo, Citibrain, ACO recycling, Evrek, Rico, and BrighterBins focus more on technology and less on user awareness and marketing. There is minimal focus on education and empowerment of end users. Our study's findings guide academics, practitioners, and policymakers to apply ambidextrousness in energy innovation, particularly in the waste-management sector. By implementing sustainable and innovative solutions, companies can not only reduce waste products, but they can also recover, recycle, and better dispose of the waste. However, to do so, companies also need to educate end users.

Keywords: sustainability; green economy; waste management; green marketing; energy management

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1. Introduction

According to the World Bank, global waste is expected to grow 70% by 2050. The increased movement of people from villages and small towns to cities creates more waste. The 2.01 billion tons of waste currently produced worldwide is expected to increase to 3.4 billion in the coming 30 years. Although high-income countries do not constitute a majority of the world's population, they contribute more per capita to waste generation. The developed world makes up 15% of its population; it generates 34% of the world's waste. Asia contributes 23% of the world's plastic waste, resulting in natural catastrophes if not managed well [1]. Waste 2.0 initiatives encourage waste management, proposing

that, firstly, creation should be avoided, and otherwise created waste should be recovered, reduced, and recycled. Waste 2.0 discourages the disposal of waste. Waste management is often overlooked in developing countries. Laura Tuck, Vice President for Sustainable Development, said, "Mismanagement of waste harms human health and local environments while adding to the climate challenge". Waste 2.0 is expected to contribute more as the government of Japan funds it through the World Bank's Tokyo Development Learning Centre (TDLC) [2].

Leading multinationals and conglomerates earn a good brand image through waste-management strategies. For instance, a few big companies are ranked as top environment-protecting companies. Accenture is ranked 1st in the environment corporate citizenship report but 15th in the overall ranking from an environmental perspective. The company has delivered remarkable achievements in protecting the environment and fostering a sustainable carbon emissions footprint by reducing CO_2 emissions per employee. The company prioritizes reuse and recycling [3].

The corporate citizen report also ranked Intel as the top contributor in the environmental domain. Since 2008, the company has recycled 75% of its waste from operations. It recycles 90% of non-hazardous trash. Estree Lauder is another company that cares about the environment. Due to the company's strong focus on waste minimization and identifying new methods of recovery/diversion, it has reached a recycling rate of more than 88.5%.

Eaton is another company concerned about the environment; it has reduced its total landfill waste from 33,400 tons to 25,100 metric tons. More than 120 of its facilities send zero waste to landfills, and the company is seeking to increase this in the near term by another 20 sites. These more prominent companies have used waste-management companies' services for better optimal usage of resources [4]. Figure 1 shows the intentions of the companies. The top priority of the companies is to prevent waste creation. Disposal is the lowest priority. Researchers have conducted a literature review and an analysis of companies in the context of sustainable energy waste management for Australia, Bangladesh, Brazil [5–7], China [8,9], Egypt [10], and from a global perspective [11–21]; environmental practices of companies are shown in Figure 1.

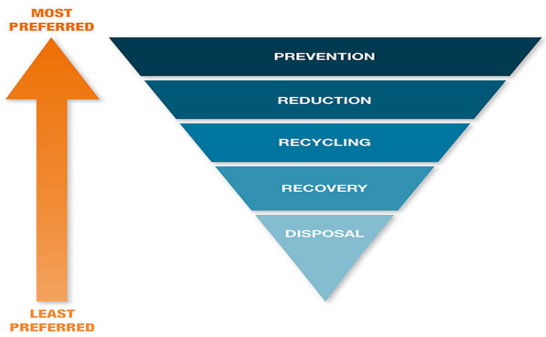


Figure 1. Companies' top priority concerning the protection of the environment is waste management. Source: Created by the authors based on a literature review of companies' practices.

Changes in environmental situations impact economic circumstances. Food loss and supply chain problems are core issues in developing countries. A study in Egypt found that the lifecycle assessment approach could help the 343 tomato supply chain companies avoid food loss [22]. An extensive review of studies on waste management in both developing countries such as India, Malaysia, and Saudi Arabia [23–26] and developed countries, e.g., Switzerland [27], was conducted involving, e.g., the lifecycle assessment approach using an innovative supply chain [28] and dumping of rock-hard waste [29]. The research provided a framework for sustainable management [30], recommending that those concerned follow the municipal solid waste standards [31] and employ a validated technology acceptance model [32]. Waste management is not only a challenge for households but is also an issue for companies in both the private and public sectors. However, researchers have

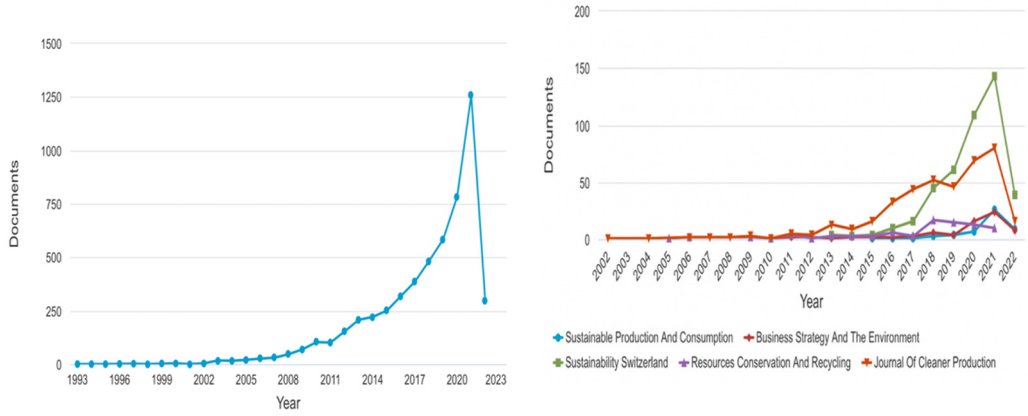
not demonstrated how these operations and behaviors can be spread in society [33–35]. Urban air pollution is becoming a concern among researchers. Thus, a modern waste-management solution is required [36–38]. Global waste is forecasted to increase by 70% by 2050. The authors claimed that putting the circular economy (CE) in the context of the UN's Sustainable Development Goals (SDG) Agenda 2030 is critical for controlling the growing waste generated by the building industry [39]. The research results support a central point of the study, which is the importance of managing both the technical and marketing side of waste-management decisions to achieve better results. Similarly, the supply chain in the leather sector is creating several risk factors because of gaps in behavior and technological initiatives [40]. Researchers have also provided holistic frameworks addressing the multiple levels of photovoltaic waste management [41], yet the missing behavioral aspects undermine the performance of the frameworks. Another study investigated ways to better manage municipal waste in Brazil. However, not studying the behavioral aspects creates limitations in the study [42]. Academics can provide better ideas and frameworks to help practitioners in waste management. Alongside actual waste, the focus on e-waste management is also increasing [43]. Thus, all these situations require researchers to study technical and marketing aspects simultaneously, as well as behavioral elements in parallel with the operational side. Past studies have been limited by strategic guidelines [44].

Waste management needs both practitioners and academics to focus on various domains, particularly in health [45], construction management [46], and urban population handling, as these are the core areas of concern for humanity. Sustainable waste management handles the environment better and helps minimize environmental degradation and contribute to society. The researchers have emphasized technological developments and integration. Therefore, more integrated systems are required to handle environmental risks better [47]. Thus, the current study reviewed the literature on ten companies that provide waste-management solutions. The research on waste management also highlighted the importance of technical and marketing domains [48].

The first objective of this research was to identify and review the available research on sustainable waste management companies with innovative smart marketing solutions using a systematic literature review (SLR) protocol. The second was to evaluate how companies employed sustainable waste-management practices to achieve innovative smart solutions and propose a conceptual model. We analyzed the literature from 1976 to 2022 on waste management trends through SLR from central databases, including the Web of Sciences and Scopus, to meet these objectives. We analyzed ten waste-management companies offering services in the USA, UK, Korea, Finland, Ireland, Turkey, Brazil, Slovakia, Portugal, Denmark, and Canada to evaluate the practical perspective. Lastly, the research findings provide guiding solutions for academicians, practitioners, and policymakers to apply sustainable smart solutions in the waste-management sector.

2. Systematic Literature Review Method

The systematic literature review method is widely used in sustainability research. This study used a systematic literature review protocol to identify and review the available research about sustainable waste management using Scopus and Web of Sciences databases. First, the general search was conducted using the label 'waste management', yielding a total of 5407 studies on the Web of Sciences. Different word combinations were used to narrow down the research area, e.g., sustainable waste and management, marketing and initiatives and sustainability, in the context of specific countries. By doing so, the number of articles was reduced to 965 for further screening. However, based on relevant themes, 102 papers are reviewed on transition in sustainable waste management and smart innovative marketing initiatives. Table A1 is highlights a summary of findings in the Appendix A. To present the visual output, Figures 2a,b–4a,b and illustrates an infographic summary of the literature on sustainable waste-management practices and smart, innovative solutions.



(**a**) (**b**)

Figure 2. (**a**) Studies on waste management; (**b**) studies published in relevant journals.

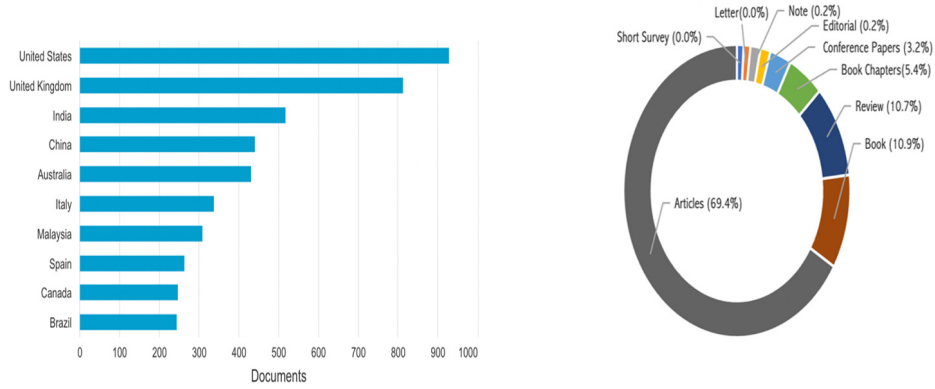


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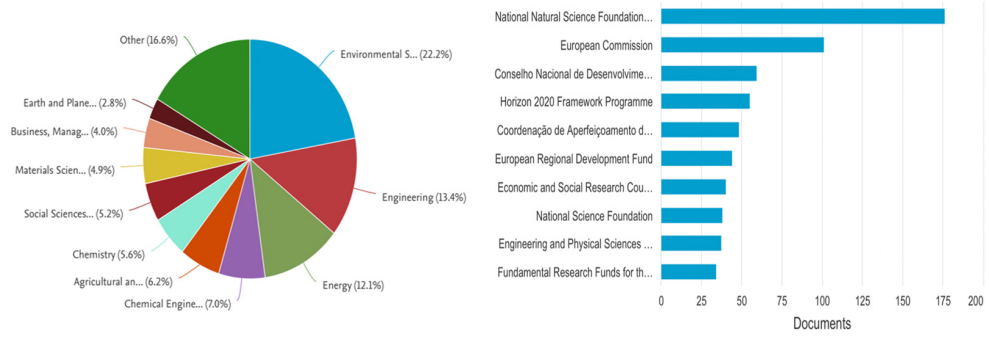
Figure 3. (**a**) Countries-wise studies by source; (**b**) studies in journals by document type.



(**a**) (**b**)

Figure 4. (**a**) Studies published subject-wise; (**b**) studies published by main sponsors. Source: Scopus and Web of Sciences (2022).

Technology is advancing rapidly. Companies are providing new models because of inventions every year. For the literature review analysis, we reviewed recent research papers to explore the role of end-user marketing in green innovation and ambidexterity lessons from ten waste-management companies worldwide. Several researchers contributed to the sustainable waste-management and behavioral perspective domain. The current research summarized the relevant literature review studies conducted on sustainable waste management from 1976 to 2022. It has been observed that, globally, researchers are studying sustainable energy, waste management, and the behavioral perspective. However, the

behavioral perspective focuses mainly on developing countries. The researchers have focused the least on behavioral and technological developments. The researchers suggest that behavioral-level investigation by practitioners and academicians can create a win-win situation for stakeholders. Table 1 highlights a summary of country-wise sustainable waste management and energy solutions based on behavioral perspectives. For a detailed overview of all relevant waste-management smart solutions studies, refer to Table A1 in Appendix A.

Table 1. Summary of the literature review: prominent studies.

Country	Sustainable Energy	Waste Management	Behavioral Perspective
Australia	[1]	[2]	[1]
Bangladesh		[3,4]	[3]
Brazil		[5–7]	[5–7]
China	[8]	[9]	[8,9]
Egypt		[10]	
Ethiopia		[10]	[10]
Global Perspective	[11–14]	[15–19]	[19–21]
India		[22,23]	[14,23]
Malaysia	[24,25]		[25]
Saudi Arabia	[26]	[26]	[26]
Switzerland	[27]	[27]	
Taiwan	[22]		

Source: Authors, based on the literature review.

3. Waste Management Industrial Side

Besides academic research, several companies are working on providing products and services in the waste-management domain. In the current study, we targeted twenty companies. These companies were analyzed in detail regarding their focus on sustainability and the environment. After a careful analysis, only ten companies were retained for the final analysis. The companies listed in Table 2 integrate sustainable waste management based on a review of academic literature. However, these companies cannot add remarkable contributions due to less focus on the marketing and behavioral side. The focus on energy has shifted from big industries to user behavior. For better waste management, companies also need users' support. More awareness and knowledge can help these companies to increase user willingness for better waste-management and sustainability decisions.

Table 2. Prominent waste-management companies' innovation and marketing approaches.

Company/Reference	Company Information	Transition in Waste-Management and Marketing Activities
Brighter BinsBelgium Source: [49]	The Brighter Bins' is one of the innovative companies in Belgium. It produces cost-effective smart sensors and solutions for municipal and commercial waste pickup. The 'Brighter Bins' sensors measure fill levels and data, sending them to either their own or a third-party platform. The platform uses sensors and artificial intelligence (AI) algorithms to optimize waste pickup and city planning.	The company contributes to waste transition through cost reduction, less heavy traffic, cutting emissions, and greener cities. Compared with others in terms of waste-management, this company is performing well on the technical and marketing side. The company claims that the cost of waste collection is up by 50%. A lower price point than its competitors help the company to manage waste optimally using a flexible solution. It has a proven open application programming interface (API) compatible with all third-party platforms. Its products fit in more than 90% of bins. The company is open to all niches for trade and business.

Table 2. *Cont.*

Company/Reference	Company Information	Transition in Waste-Management and Marketing Activities
Compology Country: USA Source: [50]	The company was founded in 2014. Its headquarters is in California. Compology's mission is to move the world's raw materials, finished goods, and waste with the smallest footprint possible.	The company provides waste-management sensors to households and industrial solutions. The company manages container inventory. It helps companies to optimize waste-collection trips. It also anticipates haul schedules and saves time for waste-collection drivers. The company is active and participates in both technology- and sustainability-related events.
Enevo Country: Finland Source: [51]	The company was established in 2010. Its headquarters is in Finland. It also provides services in Norway and Denmark. The company is well funded and has received investment from several bodies.	Enevo provides waste-management analytics solutions. It helps in improving efficiency, effectiveness, and transparency in waste management. It also monitors, predicts, and provides reports for businesses and brokers handling waste. The company could create a better image through collaboration with well-known companies.
Smart bin Country Ireland Source: [52]	The company was established in 2003. Its headquarters is in Glasnevin, Dublin. It has more than 100 clients across the globe. The company is popular in Dublin, Chicago, and Sydney and has a global partner network. The company was acquired in 2016 by OnePlus Corp, the world leader in intelligent monitoring for the waste-compactor industry.	The company provides smart bins for general waste, waste oil, textiles, used cooking oil, recyclables, fresh oil, and secure documents. Its solutions can also monitor, predict, report, and measure waste inventory. The company's marketing initiatives need focus to reach more customers.
Bigbelly Country: United States Source: [53]	The company was established in 2003. Its headquarters is in Needham, Massachusetts. The ancient company had a first-mover advantage in the developed world. The company aims to transform the way organizations manage waste and recycle by saving time, fuel, and money and beautifying public spaces.	This company provides smart, self-powered waste-management and recycling solutions. It captures and analyzes real-time data for smart, connected solutions to improve public space, quality of life, and increase operational efficiency. It provides services in cities and towns, colleges and universities, corporate retailers, and health care. Focusing on marketing and user-awareness initiatives can make the company more successful.
Sensoneo Country: Slovakia Source: [54]	The company was established in 2012. Its headquarters is in Slovakia. It provides services to cities and municipalities and waste-management companies. It has circular economy consultation companies, recyclers, consultants, and experts.	Smart, self-powered waste-management and recycling solutions. It captures and analyzes real-time data for smart, connected solutions. It improves public spaces and quality of life and increases operational efficiency. The company is focusing less on marketing. More user awareness would be vital.
Nord Sense Country: Denmark Source: [55]	The company was established in 2010. Its headquarters is in Denmark, and it also operates in the USA. It is also a G-9 waste bin manufacturer and commercial partner in the city of Copenhagen.	The company provides waste monitoring with integrated internet of things (IOT) solutions. It also provides route optimization based on bin status. The company's marketing activities are limited to websites and social media. More focus on attending seminars and projecting success is required.
Acorecycling Country: Turkey Source: [56]	The company was established in 2016. Its headquarters is in Turkey. It develops innovative solutions for smart cities and cooperates with leading manufacturers in Turkey to provide the latest high-tech solutions.	The company provides solutions to environmental issues using high-tech solutions. It offers smart reverse vending machines b-1, smart waste-management solutions, underground and semi-underground waste containers, waste monitoring with integrated IOT solutions, and route optimization based on bin status.
Evreka Turkey Source: [57]	The company was established in 2014. Its headquarters is in Ankara, Turkey. It provides waste-management software solutions. It supports smart cities using IOT to improve the environment.	The company offers waste monitoring with integrated IOT solutions. It also provides route optimization based on bin status.

Table 2. *Cont.*

Company/Reference	Company Information	Transition in Waste-Management and Marketing Activities
Ecube Labs Country: Korea Source: [58]	The company was established in 2011. Its headquarters is in Seoul, Korea. It provides services to municipalities, smart city planners, waste-collection companies, and NGOs to provide innovative IOT solutions to their constituents and stakeholders, and customers. Its products and services are available throughout the major regions of Asia (northeast and southeast), Europe, the Middle East, and North America.	Clean Cube is a smart solar-powered trash compactor that compresses garbage to hold up to eight times more than standard trash bins. Clean CAP is a smart ultrasonic fill-level sensor that can be easily installed on any container. It uses robust ultrasonic technology, allowing it to monitor any substance. The company has the potential to expand and provide services on a higher level. More focused marketing efforts would give visibility to the company.

Source: Authors, based on the literature review.

4. Results and Discussion

Several waste-management companies are operating worldwide. On the technical side, most companies have a good understanding of software and hardware. Figure 5 shows waste management's technical side. Companies are focusing on physical infrastructure, IOT technology, and software analysis. In the physical infrastructure domain, companies have contributed to hardware competence and their features. For instance, bins, cameras, sensors, and depots have been upgraded in the last few years.

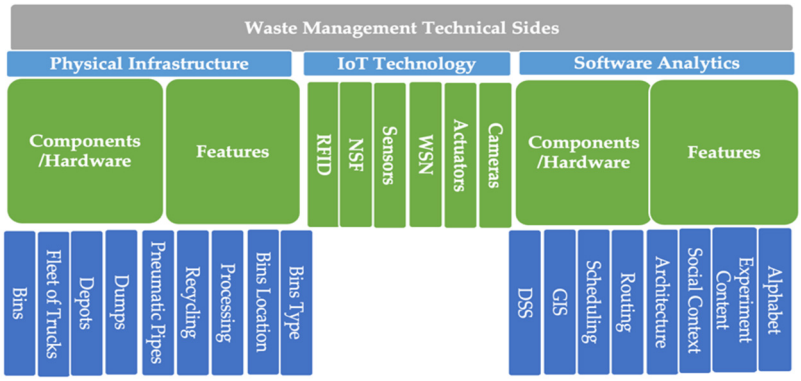


Figure 5. Waste management's technical side. Source: Authors, based on the literature review and company review.

DSS, GIS, and routing are improving. Similarly, companies have contributed to RFID, NSE, WSN, and cameras in IOT technology. The analysis of the companies is also becoming more robust, with the ability to generate reports and correct notifications. However, companies should also focus on the marketing side.

On the other hand, if we assess the marketing side, relatively new companies are taking fewer initiatives. Collaboration with world-leading companies could be a very effective method to achieve goodwill. Sustainability and environmental protection are the top areas of concern for researchers worldwide. Thus, promotion through mass media and social media is recommended for new companies. Similarly, companies must participate in technology-related events in order to reach their potential partners. There are several events and awards which companies must know about and participate in, for instance, Think, Eat, Save; Save The Food; Zero Hunger Challenge; Feeding The 5000; I Love Leftovers, and I Value Food; Love Food Hate Waste; No Food Waste; and The Pig Idea. Besides sustainability issues, companies are also looking for cost-saving initiatives such as compology (see Figure 6).

Figure 6. Waste-management companies and marketing initiatives. Source: Authors, based on the literature review and company review.

5. Findings and Discussion

Based on the extensive literature review on both the industrial and academic sides of waste management, researchers have observed a significant improvement in waste reduction, recovery, and recycling processes. However, focusing more on innovation and showing fewer tendencies towards marketing can lead to less visibility and awareness of the people. Through an analysis of LinkedIn followers and the inability of companies to educate the masses on social media channels such as YouTube and Facebook, companies are missing sizeable public support and appreciation. Thus, based on the literature review, specific and relevant articles from Scopus and Web of Science, and analysis of industry companies' initiatives, the researchers have proposed a framework (e.g., Figure 7). Companies in the 21st century cannot ignore the importance of the marketing side. Companies with public support and popularity among the masses can achieve a competitive advantage at a regulatory level. However, these companies must balance user awareness and waste management's technical side. User awareness includes developing green marketing and green environment behavior among employees. The companies' marketing and innovative technology initiatives create acceptance among the masses. Similarly, the acceptance of the people domain is also based on ease of use and perceived usefulness initiatives.

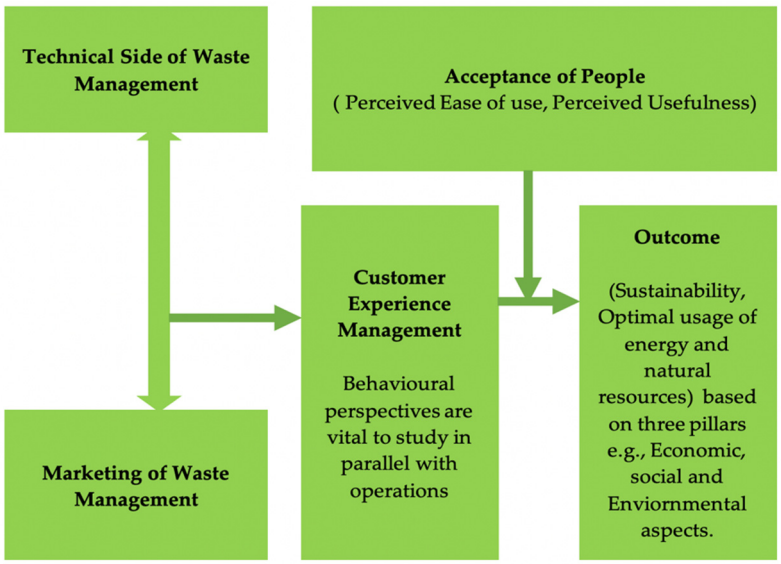


Figure 7. A framework of management marketing and Technology for Sustainability Outcomes. Source: Author self-based on literature review and companies review.

However, these steps are not sufficient. Besides marketing and technical efforts, companies must always manage the customer experience. Even after making their intentions to use waste-management technology and accept the waste-management 2.0 system clear, the customers always assess and rate the customer-experience initiatives of the companies. There is a continuous need for improvement of the customer experience. The customer experience covers the behavioral perspective of the customers. There is an additional need to highlight selected companies' efforts to help them in achieving sustainability goals. Achieving sustainable outcomes based on three pillars, e.g., economic, social, and environmental, is possible only through managing the marketing and technical side of the waste-management operations, developing a user experience, and caring about customer experience. All this ultimately leads us towards a more sustainable environment. This framework implementation can yield sustainable outcomes in the context of waste management based on academic and practitioners' viewpoints.

Based on the systematic literature review and in-depth analysis of ten waste-management companies offering services in the USA, UK, Korea, Finland, Ireland, Turkey, Brazil, Slovakia, Portugal, Denmark, and Canada concerning their technological and marketing development for the creation of a better and sustainable outcome. Overflowing garbage bins and waste collection has always been core sustainability issue for companies and are subject to corrective measures. However, apart from integrating waste-management practices, a transition has been observed toward mitigating environmental degradation in achieving sustainability goals in the past ten years. Companies are not only focused on producing less but also transforming waste into reusable resources and products. This process, on the one hand, needs enhanced cameras, sensors, root-optimization methods, and other technical developments. Still, on the other hand, it also needs marketing initiatives to increase awareness and education of the end-users. This research study recommends that academia and industry focus on sustainability and green energy projects, emphasizing innovation, technological developments, and policymaking. However, the education and empowerment of end users receives the least attention. This study also guides academicians, practitioners, and policymakers to apply ambidextrousness in energy innovation, particularly in waste management. By employing pro-environmental initiatives, companies not only reduce waste products but convert, recycle, and better dispose of the waste using the principle and practices of a circular economy. However, to do so, companies must educate the end-users. It is observed that waste-management companies, e.g., Ecube, Enevo, Smart bin, Compology, Bigbelly, Sensoneo, Citibrain, ACO recycling, Evrek, Rico, and Brighter bins are focusing more on technology and less on user awareness and marketing.

6. Conclusions

This study conducted an in-depth analysis of ten waste-management companies. Moreover, based on systematic literature reviews, this study's findings revealed that companies mainly focus on the industrial side. The consumer side receives the least attention. Therefore, to achieve success in waste-management solutions, companies should provide better services and focus on the end-users' awareness. Moreover, companies should also address the issues related to waste management's technical and marketing sides. Due to stakeholders' pressure and companies' commitment towards environmental objectives, they are expected to deliver in the field. User experience management refers to people's attitudes. If the users have seen flaws in the commitment and marketing, it can badly impact them. Better user management will be moderated by the acceptance of the people. If users accept the companies' initiatives making the sustainable, optimal usage of resources will be easy for the companies. The current study outcome is mainly based on a review of systematic literature and companies' analysis through available data and information. Future research studies should use qualitative, e.g., interviews with the experts in the field, and quantitative analysis to empirically validate the current study's proposed conceptual framework. This study also provides insight to academicians, practitioners, and policymak-

ers in the field of innovative and sustainable waste management to focus on user awareness and marketing initiatives to achieve sustainable solutions.

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Appendix A

Table A1. Literature on the connection between marketing and innovation.

Reference	Summary of Relevant Studies Reviewed
[28]	The study discussed the economic and environmental concerns of postharvest loss across the food supply chain in developing countries. The findings revealed that reducing food loss is a concern of academics and researchers worldwide. Teaching people about the optimal use of resources is vital for the betterment of future generations. A sample of 343 Egyptian tomato supply chain firms was studied to manage food and waste loss. Through the lifecycle assessment approach, food and waste loss can be avoided. The researchers suggested a smart supply chain of distributors to retailers.
[29]	The study objective was to analyze risk factors in sustainable supply chain management in an emerging economy of the leather industry. The leather industry supply chain is facing several challenges. The business industry is highly competitive. Recognizing the priorities is vital in such a situation. Through interviews with field experts and a literature review, the study addressed five dimensions, i.e., social, environmental, economic, technical, and institutional. The researchers conducted a Pareto analysis and identified the risk factors of ineffective effluent treatment, changes in consumer preference, inappropriate dumping of rock-hard waste, volatility of price and cost, and fiscal changes.
[30]	The study objective was to conduct a multi-level analysis of photovoltaic waste management and propose a holistic framework. The researcher studied the global growth of photovoltaic (PV) panel installation. PV is gaining popularity across the world. The researchers identified the gap in strategic pathway facilitations using a closed-loop supply chain (CLSC) approach. The research provided a framework for sustainable management.
[31]	The study aimed to explore the existing status of municipal solid waste in Brazilian cities through integrated administration. Using innovative methods, municipal waste-management systems are changing worldwide for the betterment of society and the environment. Thus, the purpose of this study was to create a methodology for identifying and understanding the drivers and barriers to innovation waste solutions in Brazil. The researchers recommended the practitioners should follow the municipal solid waste standards to achieve sustainable outcomes.
[32]	This study studied the impact of attitude, subjective norms, environmental knowledge, behavioral control, and households' intentions on solid waste management. The researcher validated the technology acceptance model.
[33–35]	The study was conducted in the context of Bangladesh. Based on the literature, the researchers provided guidelines for the efficiency and performance improvement of Cumilla city. Another study objective was to investigate the compliance of E-waste-management rules in the Government of Assam offices in Dibrugarh, India; with technological advancement, E-waste is increasing. India is one of the leading countries in software production. Thus, the researchers studied the compliance of E-waste management in India. A subsequent study investigated waste management and private sector participation from operational and behavioral perspectives. Waste management is not only a challenge for households but also an issue for private and public sector companies. However, the researchers did not demonstrate how these operations and behavior could be applied in society.

Table A1. *Cont.*

Reference	Summary of Relevant Studies Reviewed
[36–38]	The research study investigated waste management in the health sector. Health waste management needs more focus. If hospital waste is not managed well, it can also create societal issues. Other researchers studied waste management in the context of construction. The construction waste can be recycled to achieve sustainability objectives. The following study explored contemporary waste-management strategies for reducing urban air pollution in Taif, Saudi Arabia. Urban air pollution is becoming a concern for researchers. Urban pollution is increasing in Saudi Arabia with increased transportation and vehicle use. Thus, an innovative waste-management solution is required.
[39–41]	Global waste is forecasted to increase up to 70% annually by 2050. Household and industrial wastes are creating problems for the environment, which are leading to health issues. The researchers recommended better waste-handling techniques for sustainability. The European Union (EU) Commission has announced directives for municipal solid waste (MSW) material flow and assessment for sustainable management. The researchers also investigated the applicability of these guidelines. The construction industry is critical to a country's economic development. The industry has been penalized for operations and practices that produce large amounts of trash that can hinder the achievement of sustainable development goals (SDG). The research claimed that putting the circular economy (CE) in a context in accordance with the UN's sustainable development goals (SDG) agenda 2030 is critical for controlling the growing waste generated by the construction industry. By keeping materials and resources in a closed loop, using the CE principle can reduce waste and present viable solutions for achieving sustainable development goals.
[42]	This study was conducted using fruit and vegetable waste to produce value-added products. Source reduction and recycling demonstrated encouraging results. Moreover, it concluded that economic and environmental studies are needed. The findings proposed a viable strategy for effectively utilizing fruit and vegetable waste to develop value-added goods that are more eco-friendly, cheaper, and sustainable.
[43]	This study examined the eco-innovations based on two aspects, i.e., technological and non-technological, in the context of India, including resource recovery and practical SWM technologies. The analysis also highlighted the gaps (in awareness, acceptance of bioproducts, and advanced technologies) and recommendations based on the findings and future research areas. Researchers, businesses, and policymakers can apply eco-innovations practices to help improve the position of SWM in India and other developing countries.
[44]	The research studied the willingness to pay (WTP) for solid waste-management improvement in Hawassa city, Ethiopia. The relocation of the current landfill and the changeover from open donkey carts to covered tractors with a trash compactor for solid waste delivery are used for improvements in solid waste management. In this study, residents' WTP for improved solid waste management was estimated using a contingent valuation method. Residents were asked about their WTP using an iterative bidding approach, and data were analyzed using ordinal logistic regression. According to the findings, the survey found that residents' average monthly WTP was Ethiopian Birr (ETB) 26.57 ($0.62).
[45]	This research contributed to the body of knowledge on sustainable solid waste management by establishing a reliable hierarchical model and criticizing the causal interrelationship between waste reuse and recycling qualities. Long-term strategies for garbage reuse and recycling were highlighted. Many developing countries have attempted to solve solid waste-management issues and severely limit material reuse and recycling. The findings demonstrated that the circular economy, the informal sector, material flow analyses, policy limits, and waste treatment technology are the most significant indications for improving behaviors. The recent research was presented, and new opportunities and difficulties were identified.
[46]	To gain economic and environmental benefits from waste products, efficient management is required. Agroforestry, which involves the process of integrating a farming system with woody perennials, produces potential agroforestry residues. Land filling, thermal management, and decomposition are all traditional methods for treating agroforestry waste, each with its drawbacks. To maintain a circular, sustainable bioeconomy, waste collection, transportation, and recycling or valorization into goods such as biofuel, fertilizers, charcoal, and industrial chemicals is critical.
[47]	Solutions aimed at addressing the numerous waste-related issues were presented. To achieve long-term waste management, technical and non-technical measures must be used. Knowledge management deployment is one of the non-technical ways. In the context of waste management, knowledge management entails optimizing the use of a wide variety of existing and potential waste-management knowledge to achieve the desired outcomes. This research includes a survey of current literature and a theoretical synthesis to better understand the use of KMA in waste management.
[48]	Due to the infectious and dangerous nature of healthcare waste (HCW), its management poses major concerns to the environment, human health, and socioeconomic sustainability. Mapping the scientific development of HCW research, this study (i) identified the prominent HCW research themes and trends and (ii) provided a research agenda for HCW management towards a transition to a circular economy (CE) and a sustainable environment. This research aimed to provide a significant contribution to the body of knowledge on the subject of HCW management.

Table A1. *Cont.*

Reference	Summary of Relevant Studies Reviewed
[59]	Municipal solid waste (MSW) reflects the society that produces it, and it has a negative influence on human and environmental health. As plastic and electronic consumer products proliferate worldwide, people are abandoning growing volumes of garbage, and the composition of that waste is becoming more complex than ever. At the same time, the world is becoming increasingly urbanized. Because of these changes, cities will be under more pressure to manage waste in a sustainable manner. To build a comprehensive MSW management system that includes treatment, substantial research has been conducted worldwide. This study aimed to examine municipal solid trash among eight eastern coastal regions.
[60]	Solid waste management (SWM) is a vital public health service that is sometimes overlooked. Public health emergencies, such as the COVID-19 outbreak, further deteriorate the SWM problem. The COVID-19 pandemic induced catastrophe and altered the dynamics of waste generation and management in every sector worldwide, necessitating specific attention. Unpredictable trash quantity and composition changes also pressure policymakers to react quickly. This research focused on the fundamental issues the SWM sector encountered during the COVID-19 pandemic and the underlying possibilities for filling the holes in the present system.
[61]	This research conducted a comprehensive review of the literature on the energy-growth nexus to identify the most authoritative sources of information in the form of journals, authors, and publications. This study not only identified and categorized well-known approaches used in energy-growth nexus analysis, but also uncovered intriguing content-based discoveries, using quantitative measurements for the top 50 publications ranked by the highest average citations per year. This survey used a unique method of picking articles objectively, allowing the opinions of the scientific community to take precedence over the authors via subjective assessments.
[62,63]	This research studied changes in energy economics. The dynamics of energy management are changing. Researchers are expected to focus on sustainable sources of energy. Estimating the cost of capital for renewable energy projects was the core goal of the study. Renewable energy projects will improve environmental protection.
[64]	This study conducted a detailed literature review on the idea of convergence of three areas, i.e., energy, economy, and environment. The research systematically evaluated the literature on energy consumption convergence, CO2 emission convergence, and energy efficiency convergence. Because these three notions are interrelated, the study focused on them. Energy consumption produces emissions, but if the former is conducted in a way that prioritizes saving and efficiency, energy efficiency can be accomplished. Thus, if the concept of energy consumption convergence is to be investigated entirely, the aspects of emissions and efficiency cannot be overlooked.
[65]	This research reviewed the genuine efforts of managers to promote sustainability as a priority rather than using the sustainability agenda to increase sales. This study explained the impact of brand equity and promoting sustainability because of efficient recycling. The paper concluded that focusing on recycling honesty and promoting a sustainability agenda improves brand equity.
[66]	The author studied waste management in the context of landfills and sustainability, explaining the landfill concept for handling solid waste. The author concluded that sustainable public procurement could be extended at the country level.
[67]	This research discussed circular economy (CE) in the context of industry 4.0. The increased focus on CE is impacting technology and enhancing the efficient use of resources. The study conducted a literature review on smart waste management and provided helpful insight for the industry. However, the limitation of this study is it only focuses on the user perspective.
[68]	The research concluded that sustainability is the only solution to existing socio-economic issues. This study discussed sustainability in the context of airports and the aviation industry. The research studied airport waste handling, cleanliness, and other matters of ASEAN countries. Various dimensions of energy problems, such as emissions and water flow, were also discussed within waste-management strategies. The author found that the Asian countries commit more strongly to SDG 09, 11, 14, and 15 goals. However, there is a need for more focus on addressing sustainability-related issues.
[69]	The authors studied fresh products, food, and food waste-related issues to suggest green environment-related initiatives to practitioners, academics, and policymakers. A multinational retail enterprise and event were studied to see the application of lean management in the retail sector, particularly for food-related ties, for better sustainability performance.
[70]	The authors studied waste management and recycling practices to develop a political understanding of waste handling in the private sector. The core agenda of the companies should be waste reduction. Once the waste is produced, it should be recycled and disposed of. The paper presented the fieldwork activities and interviews of waste-management companies.

Table A1. *Cont.*

Reference	Summary of Relevant Studies Reviewed
[71]	Waste management is becoming a core issue in Nairobi. The authors studied Mathare Valley Nairobi's community relations, sanitation, urbanization, and water management. The researchers guide the decision makers on waste management to provide better services to the youth and the community.
[72]	The researchers studied green policy and sustainability. Green reputation and performance are emerging concepts in sustainability. The researchers studied the top 500 publicly traded companies located in the USA. Employing a mixed-methods study, the authors concluded that, currently, most organizations are using a reactive approach. Proactive strategies can improve the performance of companies in the sustainability domain.
[73]	The researchers studied hotel initiatives and practices in the context of sustainability. Most hotels prefer a better and greener environment. A green environment helps hotels in sustainable marketing initiatives. Besides a better market strategy, green marketing also provides the opportunity for cost-cutting, less usage of energy resources, and better waste-disposal management. Besides the benefits of green marketing, the researcher also studied the challenges of lower public institution support and environmental issues.
[74]	The study investigated sustainability and the supply chain in the Malaysian automotive industry. As green innovation is receiving the attention of researchers and practitioners worldwide, Malaysia is no exception. Malaysia has a better environment as compared with other developing countries. The government is also concerned about it. However, compared with other Asian countries, Malaysia has a larger automotive industry, which inevitably creates waste. Therefore, the study focused on marketing demand, internal initiatives, and environmental regulations' impact on green initiatives. Based on the findings, the researchers proposed a strategic plan.
[75]	Using a mixed-methods design, the researchers studied the impacts of cultivation theory, communication, and sustainability on value creation. The findings concluded that the festivals do not communicate sustainability-related messages through their websites. Companies do not create roles of sustainability-related responsibilities. The individual interviews were conducted to understand the necessary communication. The authors used cultivation theory in the tourism context and concluded that a proactive sustainability role would serve both the environment and companies.
[76]	The authors studied the environmental discourse of companies on solid waste management listed in BM&FBOVESPA, assuming that companies are polluting the environment. The quantitative data from earlier studies confirmed the impact of solid waste on the environment. In line with prior research findings, it was concluded that companies operating in environmentally harmful segments are more likely to provide environmental information voluntarily.
[77]	The researchers assessed the plastic waste impact generated through household sources, mainly plastic waste, its lifecycle, and its role in the circular economy. Littering is a severe challenge in the commercial world. According to the cost–benefit analysis, recyclers are the weakest link in the value chain and recycling soft plastic and mixed polyolefin is typically not viable. This raises the possibility of low-quality materials being exported outside of Europe. Finally, the findings revealed that increasing the recovery and recycling of plastic packaging and boosting the downstream plastic market is crucial for meeting the European recycling objectives of fifty-five (55) percent by 2030.
[78]	Recycling is now an integral part of countries' waste management. The study was conducted on solid waste management reuse of paper bags to protect the environment. Waterways, railways, truck stations waste reuse methods were studied. The study was conducted in the context of Bangladesh. This study discovered that a seemingly silent, methodical, smooth, and clean reuse chain had been developed in the Khulna metropolitan region under private initiatives. Its sustainability has been proven over time in a country without any official or formal subsidies. However, adequate alignment of the upper and lower chains in the material flow path and personal hygiene training for personnel would help the current reuse plan to achieve even better results.
[79]	The struggle for businesses to consistently give their clients the highest return on investment (ROI) has grown more challenging in the global market. A corporation can respond to these issues in various ways, including new product development, higher market capitalization, cost-cutting measures, and quality control. This study also discussed consumer satisfaction and the long-term viability of quality improvement programs. It created a system dynamics model based on the qualitative case study and collected and recorded data in a heavy industrial manufacturing setting.
[80]	National and regional governments are insisting that waste and resource management sector companies adopt a circular economy (CE) approach. The context for such hope for change is neoliberal environmental governance. The findings of this study suggested that, for proponents of CE standards, improving recycled material quality is critical for increasing confidence and trust in developing markets. The private sector is increasingly delivering results through public–private partnerships. Likewise, voluntary quality assurance standards for waste and resource movements are becoming increasingly important to global markets and commerce.

Table A1. *Cont.*

Reference	Summary of Relevant Studies Reviewed
[81,82]	Global reporting initiatives have drawn on sustainability using signaling theory. The relationship between green logistics performance (GLP) and sustainability reporting (SR) was investigated in this study. In addition to this, the moderating role of corporate governance was examined in the relationship between GLP and SR. The data were collected between 2007 and 2016 from 117 countries. Specifically, the results revealed that GLP has a strong and favorable relationship with the logistics industry's availability and volume of SR. The findings are essential for developing nations with lower LPI scores than industrialized countries. Engaging in green logistics practices and building regulations to support them might be beneficial.
[83]	Key strategies and techniques, e.g., sustainability strategy, environmental strategy; pollution prevention; sustainable value, and green team are important. Regardless of their size, location, or primary market, manufacturing companies must implement sustainable techniques such as lean principles, process integration, and inter-organizational partnerships to achieve their business objectives. The findings revealed that combining lean principles with a green model may enhance process flow and staff morale while lowering the risk of environmental and regulatory non-compliance. Furthermore, environmental and human health issues are frequently overlooked in lean projects influencing consumers and stakeholders across the product life cycle. From a lifecycle perspective, manufacturing companies using lean methodologies can risk cost under-optimization and waste reduction.
[84]	The research investigated how the CSR initiatives of retailers can improve sustainability. Retailers are under growing pressure to reduce their businesses' internal and external environmental implications. They are gradually implementing various corporate environmental sustainability (CES) measures and strategies. Understanding the motives for merchants to implement CES methods (as well as the sorts of measures prioritized) is essential for calculating the potential environmental benefits. Companies should report their sustainability progress, motivating their employees to implement successful solutions.
[85]	The researchers studied green hotels' environmental sustainability. Environmental sustainability has been an important subject, especially in the hotel industry. As this business has grown, its ecological implications have become more visible, raising worries about how the industry deals with this issue. The COVID-19 outbreak has caused setbacks in environmental performance, resulting in increased non-recyclable waste. However, according to the findings, some hotels had time to revise their strategy and implement new green measures to boost staff knowledge. This study intended to understand sustainability assumptions and developed novel methods for hotel environmental management.
[86]	The researchers studied lean and green manufacturing in the supply chain context. The companies are under pressure to boost production while lowering costs and increasing quality. Lean manufacturing (LM) has been widely used by businesses to minimize waste and accomplish success. However, these businesses have been compelled to comply with several environmental rules due to a scarcity of natural resources and high pollution levels. Furthermore, environmental activities have become a crucial differentiator in the marketplace. The proposed technique identifies essential practices that support the execution of a lean and green strategy in concert. These practices were also graded, which allows management to prioritize their improvement efforts. The findings suggested that some trade-offs may be developed for a few behaviors depending on the product type, implying a certain risk level.
[87]	The paper discussed the cellular business models in the coffee value chain. The circular economy (CE) offers a viable alternative to the present 'take–make–dispose' economic paradigm, which is characterized by excessive energy consumption and trash generation. There are several instances of CE implementation in the literature, but few focus on complicated product value chains. There is a scarcity of sector-specific knowledge regarding obstacles and facilitators. Using a case study method in the context of the coffee business, this study highlighted the key barriers and facilitators. The first hurdle identified was a company's sensitivity to identity and market perception concerning implementing CE activities. Second, knowledge in CE literature frequently alludes to the technical barrier, where it was discovered that when beliefs of a linear economy are inaccurate, more detailed fact-based communication can be a facilitator for CE projects. Finally, there must be direct engagement.
[88]	The study examined the present situation of plastic value chains in Africa and the possibility for African entrepreneurs to contribute to a circular plastic economy through digital technologies. The current projects are encouraging evidence of progress in addressing the environmental and social implications of Africa's plastic value chains. However, policy changes will be required to enable the scaling-up of local start-up businesses, address regulatory barriers to digital solutions, create markets for recycled plastic materials, and implement extended producer responsibility regulations to transition to a more sustainable, circular value chain.

Table A1. *Cont.*

Reference	Summary of Relevant Studies Reviewed
[89]	This research studied sustainable practices of the Indian oil and gas industries, using the interpretative structural modeling (ISM) technique to identify and analyze major hurdles to implementing sustainable practices in the Indian oil and gas industries. The proposed model's study implications are to assist managers in determining the relevance of the barriers and prioritizing or eliminating them for implementing sustainability. This is the first time the ISM technique has been used to investigate the interdependencies among the significant obstacles to the Indian oil and gas industry. The research findings will guide managers at all levels of a business on how to adopt sustainable practices effectively.
[90]	The purpose of this study was to develop a review of the literature on green hotels. Green hotel idea development and execution are relatively recent endeavors in the hospitality industry. It can be considered a component of a developing global environmental consciousness. The hospitality business is one of the fastest-growing industries on the planet. Customers' desire to financially support environmentally friendly hotel operations was explored. Theoretical underpinnings of marketing tactics were examined. The need for communication among the many parties engaged in hotel operations was emphasized.
[91]	Food-waste management is a challenge. This issue has received very little attention in the literature. Food waste is a serious problem worldwide. It is a prelude to a large number of socioeconomic issues troubling modern civilization. Surplus food redistribution in strategic contexts is a less explored global problem. This study aimed to address a surplus food redistribution framework in strategic contexts, allowing for a smoother exchange of surplus food in developing nations. This study's findings and methodology will greatly improve current and future excess food distribution efforts and provide critical assistance to solve global food insecurity and waste concerns.
[92,93]	Since plastics are moldable, lightweight, and typically seen as highly recyclable, they are becoming a more popular material option in designing and developing complicated consumer items such as vehicles. However, recycling the heterogeneous plastics used in such long-lasting things is a complex process. It offers different circumstances than how simple products such as water bottles are recovered through curbside or container recycling operations. This study examined these issues and numerous alternatives to plastic recycling to change people's perceptions of it and increase its sustainability. The study used the car industry as an example, but the same principles may be applied to a wide range of plastic components from similar complicated goods.
[49]	The proper management of chemical compounds is a priority for the countries in the North American region's environmental agenda. Mexico already understands the identification and dangers of the chemical compounds on the market thanks to this initiative's efforts. However, it still does not know what procedures and goods are involved in their usage. To this day, efforts are still being made to discover possibilities and obstacles in managing chemical compounds in the productive sector. Given its use of chemical substances in its activities, the healthcare industry has been active in improving chemical substance management. Furthermore, because of its role in diagnosing and treating disorders associated with chemical exposure, this sector has a dual obligation.
[50]	Globalization is demanding that companies should adopt sustainable practices to protect the environment. They display environmental care and concern in their activities and products. The author explained the sustainable effects of the China–Pakistan Economic Corridor (CPEC), which compromises infrastructure and energy initiatives in Pakistan with the help of China. The most important considerations in building sustainable reverse logistics (RL) recovery alternatives are management, influence on biodiversity, and economic growth. Furthermore, because of their large economic and environmental consequences, remanufacture and reuse rank first and second among RL recovery methods. Recycling and resale rank last due to their high costs and current cutting-edge technology. In the case of CPEC, from the perspective of a developing country, namely Pakistan, little work has been carried out addressing sustainable modeling in RL strategies employing a mix of VIKOR and GRA approaches exposed to a fuzzy environment.
[51]	The researchers studied green procurement in the context of Hong Kong. Facilitating the broader use of green procurement in building developments has been a key issue in the construction industry, given the urgent need to improve industry operations in a green, safe, and cost-effective manner. Forming a fully functional green material market would assist in promoting the concept of green procurement and progressively cutting material prices, which would give insight into the variables which are vital in promoting a greener environment. It is also vital to actively involve suppliers in providing performance specifications for building materials.
[52]	The researchers studied the consumers' behavior regarding sustainability. Human consumption habits are putting an immense strain on the planet's resources, pushing it beyond capacity. These consumption patterns must be made more long-term. As a result, this research aimed to discover the main enablers that drive sustainable customer behavior. The research findings might benefit many parties engaged in acquiring, using, and disposing of electronic items to strengthen their sustainability activities. This is the first study that investigated the facilitators of sustainable consumer behavior from a temporal and spatial perspective.

Table A1. *Cont.*

Reference	Summary of Relevant Studies Reviewed
[53]	The study discussed the business strategy, capability maturity model, and life cycle enhancement. The UNEP life cycle initiative has been working to develop and disseminate a life cycle management–capability maturity model (LCM-CMM) that will fully operationalize and eventually mainstream life cycle assessment (LCA) into all aspects of business, including product development, marketing, and strategic decision-making processes. Based on the experiences of sustainability leaders, the capacity framework outlines a logical process of skill building. The firms were able to use the concepts to create accurate, representative assessments of organizational maturity and to recognize reasonable improvement projects that provided some financial value in the short term, addressing a management system gap identified in the maturity assessment, and which could be completed within the contract's timetable deadline (6 to 9 months).
[54]	The study focused on Agri products' life cycle. Particularly, the coffee beans in Brazil were studied. This research yielded critical findings to better understand coffee's production techniques and environmental implications. Agricultural methods provide a variety of environmental features. The quantity of pesticides used in agriculture is closely proportional to agricultural methods such as tillage rotation, plant density, etc. This study can be replicated to reflect changes in natural resource management, such as land usage, new farming methods, and fewer fertilizers and pesticides.
[55]	Companies focused on energy development substitute for product development, proactively developing products that have less impact on the environment. This study's core agenda was how product performance could improve sustainability goals. The government is also pushing organizations to produce environmentally friendly products. At the micro-level, there is a general awareness of sustainable packaging creation and the usage and importance of tools and procedures to enhance manufacturers' environmental performance. A large-scale study was conducted to illustrate the current state of sustainable product and process development methodologies employed by manufacturers of all sizes and types worldwide as part of their current operating and corporate policies and greener efforts.
[56]	The study focused on biomass recovery, as sustainability is the core agenda of all energy firms. Today's companies are expected to create operational efficiency, producing more energy with the least utilization of natural resources. Fossil fuel energy is one method for companies. However, it is impacting the environment. Therefore, research focuses on alternative sources of energy. Despite unresolved challenges with photosynthetic efficiency and biomass yield, microalgae-derived biofuels might eventually replace a significant amount of the fossil fuels needed to fulfill rising energy demand.
[57]	In 1994, biomass was providing 14% of the energy. However, it was mainly in the shape of old-style wood fuel, dug, and residues. The core issue of biomass is it can be hazardous to the environment. The study emphasized modernizing biomass energy for better land use. For the protection of the environment, the researchers explained the substitutes which would ultimately create less pollution.
[58]	The research studied the use of local resources for industries. Economic globalization and the associated proximity of countries and regions have not only failed to demolish local areas but have instead emphasized their importance. In many situations, the territorial component has gained in value in tandem with the globalization process as an essential pillar for progress and the benefit of the population, pushed by development programs that prioritize endogenous assets and sustainability.
[94]	Sustainability is a vital strategy for manufacturing industries to address major environmental issues. Stakeholders' growing ecological awareness is forcing manufacturers to adopt green practices to achieve sustainability goals.

Source: Authors, based on the literature review.

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