

Circular Economy Practices in Indonesia's Medical Device Industry: PT Kimia Farma and PT Kalbe Farma (2020-2022)

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ABSTRACT

Indonesian medical device industry experienced significant demand acceleration during COVID-19 pandemic (2020-2022), which challenged conventional manufacturing practices and highlighted import dependencies. This research employed qualitative analysis of official sustainability reports from PT Kimia Farma Tbk and PT Kalbe Farma Tbk to examine implementation of circular economy principles as regenerative approach that maximizing manufacturing resource value. The study identified positive outcomes following the implementation of circular economy practices, evidenced by waste reduction, material recycling, and resource efficiency. The implementation enhanced national medical device industry resilience, improved resource efficiency, and reduced negative environmental impacts, supporting both economic ecological sustainability. This offered new insights into strategic decision-making and served as a reference for empirical studies on maximizing sustainable productivity within the sector.

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1. INTRODUCTION

The Indonesian medical device industry, which serves as a fundamental pillar in the national healthcare system, faced unprecedented and complex challenges during the COVID-19 pandemic spanning from the year 2020 to 2022. This era was primarily marked by a significant and sudden demand surge for medical equipment and protective gear, pushing the industry's conventional manufacturing practices to their absolute limits. Furthermore, this intense pressure revealed a heavy, systemic dependency on global imports for both critical raw materials and finished medical products. This dependency became acutely highlighted during the peak of the pandemic, which first emerged in Indonesia in March 2020 and was later officially declared over on June 21, 2023, by Presidential Decree No. 17 of 2023. Prior to the pandemic, the industry was characterized by steady, predictable growth and increasing investments in localized research and development; yet, it remained deeply entrenched in a linear economic model, heavily reliant on imported technological components and consumable materials.

The pandemic-induced market demand, particularly for personal protective equipment, ventilators, and essential medical supplies, strained the industry's supply chains significantly. The Indonesian government's subsequent push for localized manufacturing to independently meet these domestic demands brought to the forefront the absolute necessity of rethinking traditional production and consumption models. This precarious situation underscores the critical need for a more sustainable, resilient, and self-sufficient industrial approach. The medical device industry, previously recognized as a burgeoning field with an estimated annual growth rate of 11.9% extending until early 2024 (Burhanudin Akbar & Putri, 2023), now faces the dual, interconnected challenge of drastically

reducing its high import content while simultaneously addressing escalating environmental and ecological concerns associated with industrial waste.

The circular economy concept presents a profoundly transformative approach to mitigating these exact challenges. Defined as an innovative, sustainable economic system deliberately designed to counter the inherent limitations and wastefulness of conventional linear 'take-make-dispose' economic models, the circular economy heavily emphasizes resource efficiency, perpetual material recovery, and drastic waste reduction. Key theorists and institutions, such as the Ellen MacArthur Foundation (2013), Stahel (2016), and Geissdoerfer et al. (2017), have extensively underscored core aspects of this paradigm. These include reducing systemic inefficiencies, promoting aggressive reuse, repair, recovery, and recycling mechanisms, and fundamentally encouraging regenerative economic models that decouple economic growth from finite resource consumption. These conceptual mechanisms are commonly depicted in theoretical models known as the Circular Economy Butterfly Diagram, which maps the continuous flow of technical and biological materials.

A comprehensive review of existing literature suggests that strictly implementing circular economy frameworks can significantly reduce systemic inefficiencies in industrial resource use (Blomsma & Brennan, 2017; Ghisellini, Cialani, & Ulgiati, 2016) and substantially enhance material recycling and reuse protocols (Kirchherr, Reike, & Hekkert, 2017). Furthermore, transitioning to this model can lead to measurable waste reduction (Ritzén & Sandström, 2017), pollution containment, and significant carbon emission mitigation (Webster, 2017). Economically, adopting a circular economy can lead to substantial long-term cost savings (Lewandowski, 2016) and foster heightened industry competitiveness and technological innovation (Murray, Skene, & Haynes, 2017). From a national security perspective, it directly reduces import dependence (Yuan, Bi, & Moriguchi, 2006) and ensures the stability of raw material supplies (Tukker, 2015), all while raising public and corporate awareness regarding environmental and public health intersections (Ghisellini, Cialani, & Ulgiati, 2016; Webster, 2017).

Within the structural framework of the circular economy concept, eight key determinants have been identified that directly influence its successful effectiveness and industrial implementation. First, *Product Design and Innovation* dictates that the initial design of products must facilitate future recycling, repair, and recovery. Second, *Consumer Awareness and Participation* highlights that choices for environmentally friendly products and service-based business models over strict ownership can forcefully drive the circular economy. Third, *Cross-Sector Collaboration* emphasizes that cooperation between distinct industry sectors, governmental bodies, and other stakeholders is vital for creating sustainable value chains.

Fourth, *Government Regulations and Policies* are crucial for establishing compliance mandates and incentives for waste reduction at the macro-industrial level. Fifth, *Resource Management and Supply Chain* integration ensures the efficient use of sustainable raw materials throughout production. Sixth, *Technology and Infrastructure* development is necessary for advanced recycling and waste processing. Seventh, novel *Business Models*—such as product-as-a-service—are essential in prolonging product lifespans. Lastly, *Information Transparency and Openness* regarding production methods and material life cycles enables all stakeholders to make informed, sustainable choices.

According to Geissdoerfer et al. (2017), the circular economy paradigm serves as a holistic sustainability framework proposing a definitive shift away from degenerative production to one that is regenerative by design.

Therefore, quantifying this shift requires the evaluation of resource productivity, waste reduction efficacy, and energy efficiency. Based on these theoretical foundations, this research aims to measure the effectiveness of circular economy implementation specifically within the Indonesian national medical device industry. Furthermore, it seeks to identify the institutional barriers and potential strategic solutions related to the adoption of these practices. The significance of this study lies in its potential to contribute empirically to sustainable industrial practices, illuminating how these approaches can mitigate the negative environmental impacts of heavy manufacturing while promoting economic resilience, public health improvements, and ecological sustainability in the post-pandemic era.

2. RESEARCH METHOD

This research employed a rigorous qualitative approach, focusing exclusively on the in-depth analysis of official sustainability reports published by two of the most prominent companies operating within the Indonesian medical device and pharmaceutical industry. Qualitative research was deemed the most robust and suitable methodology for this study due to its inherent ability to provide profound, contextualized insights into complex organizational phenomena, such as the multi-faceted adoption and impact of circular economy practices within a highly specific, regulated industrial context.

The strategic decision to utilize corporate sustainability reports as the primary data acquisition source was driven by the immense richness and factual density of the information these official documents contain regarding a company's environmental footprint, operational governance, and sustainability best practices. These public disclosures not only offer detailed, chronologically mapped descriptions of the environmental initiatives undertaken but also provide critical corporate reflections on the operational challenges faced and the quantitative outcomes achieved. Such depth of institutional information is absolutely vital for understanding the complex nuances and friction points of implementing overarching circular economy principles in a real-world, high-stakes industrial setting. Moreover, given that this study specifically targets the highly volatile period of the COVID-19 pandemic (2020-2022), these reports present an unprecedented, unique opportunity to explore precisely how major corporations pivot and adapt their sustainability strategies in direct response to extraordinary macro-environmental crises.

The criteria for selecting the relevant sustainability documents were carefully defined, documented, and executed to ensure the absolute comprehensiveness, validity, and relevance of the research data. This protocol ensures that the research remains deeply grounded in robust scientific methodology principles, which are generally accepted as the gold standard in qualitative research frameworks (Denzin & Lincoln, 2017; Patton, 2014). The specific targeted documents were the official annual sustainability reports of PT Kimia Farma Tbk and PT Kalbe Farma Tbk. The precise criteria utilizing for document screening and final selection are detailed comprehensively in Table 1.

Table 1. Document Selection Criteria

Criteria	Description
Relevance to Topic	The selected documents must be closely and explicitly aligned with the specific themes, research questions, and hypotheses posed in this study, particularly concerning corporate sustainability practices and circular economy impacts within the medical sector.
Authenticity and Source	The reports must be completely authentic and originate directly from credible, verifiable corporate sources. As official disclosures submitted to regulatory bodies, they provide first-hand, authoritative insights into institutional achievements.
Time Period	Documents strictly spanning the consecutive years from 2020 to 2022 were selected. This timeframe is crucial for capturing the evolution, disruptions, and adaptations of sustainability strategies directly caused by the COVID-19 pandemic.
Quality and Accuracy	The documents must exhibit a high standard of professional quality, demonstrated by clarity in writing, precise quantitative data presentation (e.g., emissions metrics, waste tonnage), and reliable, auditable interpretations of corporate activity.
Readability and Accessibility	The corporate sustainability reports must be readily accessible in the public domain and written in a structured manner conducive to efficient dissection, coding, and thorough qualitative analysis by researchers.
Diversity and Representation	Selecting reports from two distinct, major market players (PT Kimia Farma and PT Kalbe Farma) provides a broader, comparative perspective on diverse strategic approaches to sustainability, significantly minimizing single-company bias.
Language	The reports must feature accessible language styles that eliminate operational ambiguity, ensuring that technical sustainability nuances are accurately interpreted and easily understood by researchers and public stakeholders alike.
Exclusivity and Uniqueness	The documents must offer unique, company-specific insights and proprietary strategic viewpoints regarding sustainability practices that are not commonly discussed or available in secondary media sources.

A detailed thematic analysis technique was subsequently conducted on the selected dataset of sustainability reports. This systematic procedure of data coding and theme development ensures a

highly rigorous and verifiable approach to qualitative data analysis, ultimately providing a robust, scientific foundation for the study's eventual findings and conclusions. The chronological thematic process executed in this research consisted of six sequential steps.

First, *Familiarization with Data* involved an immersive, repeated reading of the selected reports. During this stage, extensive notes were taken, and preliminary ideas for thematic codes were developed to gain an in-depth understanding of the overall content context. Second, *Generating Initial Codes* required systematically coding the data by identifying and highlighting exact text excerpts that appeared highly significant in relation to the eight determinants of the circular economy. Third, *Searching for Themes* involved collating the identified codes into potential thematic groupings. This required an interpretative, analytical stance to cluster codes meaningfully. Fourth, *Reviewing Themes* necessitated a critical evaluation of the themes against the entire dataset to ensure they accurately represented operational patterns, resulting in the refinement, splitting, or merging of themes. Fifth, *Defining and Naming Themes* required establishing clear, definitive boundaries for each theme, analyzing exactly what each captured regarding the research objectives.

Finally, *Producing the Report* involved compiling the results of the thematic analysis into a coherent, academic narrative that explicitly linked the institutional practices back to the foundational theories of the circular economy.

3. RESULTS AND DISCUSSIONS

Implementation Practices Overview

Based on the thorough qualitative analysis of the official sustainability reports published by both major corporations as part of their capital market disclosure obligations, distinct evolutionary paths in their circular economy (CE) implementation strategies were observed. A comparative chronological breakdown of the primary focus areas for PT Kimia Farma Tbk and PT Kalbe Farma Tbk regarding CE implementation from 2020 to 2022 is meticulously summarized in Table 2.

Table 2. CE Development Comparison (2020-2022)

Company	2020 Focus	2021 Focus	2022 Focus
PT Kimia Farma Tbk	Crisis Response & Basics: Increasing production capacity for COVID-19 related products; maintaining involvement in government health access programs; initiating foundational commitments to reducing severe environmental impacts from immediate manufacturing surges.	Consolidation & Efficiency: Shifting focus towards developing sustainable health product lines; broad implementation of CE principles in general waste and resource management; strict monitoring for increased energy efficiency and reduced baseline utility consumption across plants.	Integration & Social Impact: Developing overarching strategies to support UN SDGs; profound integration of CE in deep operations; massive initiatives to improve local community welfare through sustainable practices, specifically highlighted by the OLIS program.
PT Kalbe Farma Tbk	Waste & Emission Control: Focusing heavily on increasing production while simultaneously scaling industrial waste management protocols; driving initial energy efficiency initiatives; fostering early-stage collaborations with external parties for rapid product innovation to combat supply chain halts.	Ecosystem & Education: Implementation of eco-friendly technologies in standard production; massive focus on developing a resilient, local raw material ecosystem; increasing community engagement; widespread internal education regarding long-term corporate sustainability.	Green Manufacturing Advancements: Implementation of sophisticated material recycling and reuse initiatives; major transition to green manufacturing through automation and digitization; strategic collaboration with suppliers to ensure end-to-end supply chain sustainability.

Effectiveness Assessment: PT Kimia Farma Tbk

An in-depth assessment of PT Kimia Farma Tbk reveals a highly structured, progressive adoption of circular economy paradigms tailored to mitigate environmental degradation while boosting socio-economic resilience. In 2020, amidst the operational chaos of the pandemic, the company laid down a robust "Commitment to Green Industry," ensuring strict compliance with evolving environmental

management regulations. Their initial approach heavily prioritized immediate resource efficiency—specifically concerning the conservation of water, electricity, and critical raw materials. They successfully integrated the fundamental principles of Reduce, Recycle, Reuse, and Recovery (the 4Rs) directly into their medical device production pipelines. Furthermore, the early adoption of low-carbon technologies served as a vital cornerstone in their long-term strategy to systematically reduce the negative ecological impact of their heavy industrial operations.

By 2021, rather than introducing fragmented new programs, PT Kimia Farma Tbk strategically opted to consolidate, refine, and deepen the circular economy programs formulated in the previous year. This consolidation phase was critical for institutionalizing sustainable behaviors across their vast manufacturing network. The culmination of these efforts was profoundly evident in 2022 with the highly successful launch and scaling of the OLIS (Essential Oil Waste Processing) Center program. This specific initiative stands as a premier empirical example of a fully realized circular economy business model. The OLIS program was ingeniously designed to transform hazardous patchouli plant waste into highly valuable derivative products, specifically commercial-grade soaps (hand soap, bathing soap, and dish soap).

The program yielded extraordinary multi-dimensional benefits. Economically and socially, it directly increased the income and overall quality of life for local agricultural communities. The company allocated IDR 748,000,000 in vital funding to empower 7 distinct farmer groups across Blitar and Bali, resulting in the sustainable development of 21.3 hectares of patchouli plantations. This initiative generated significant revenue, with essential oil sales to PT SIL reaching IDR 1.78 billion by the end of 2022, and elevated the average farmer's harvest income from IDR 5.9 million (2021) to over IDR 7 million (2022). Environmentally, the program drastically reduced the toxic discharge of essential oil waste into the local biosphere. The measured holistic impact of the OLIS program was exceptionally well-distributed: contributing 52.22% to economic sector growth, 35.99% to social sector empowerment, and 11.79% to environmental sector recovery. Additionally, internal efficiency audits revealed that their strictly applied energy savings protocols resulted in electricity consumption cost reductions of IDR 68.05 million annually.

Effectiveness Assessment: PT Kalbe Farma Tbk

PT Kalbe Farma Tbk's trajectory demonstrates a highly technical, data-driven approach to circular economy implementation, heavily emphasizing measurable emissions controls and advanced green manufacturing. In 2020, the company established a comprehensive baseline by meticulously calculating greenhouse gas (GHG) emissions originating from diesel, compressed natural gas, and grid electricity usage across all production hubs, identifying a total emission volume of 77,959.25 tonnes CO₂eq. To aggressively combat this, they implemented stringent emission controls by maximizing boiler performance efficiency and mandating the use of environmentally friendly refrigerants. Concurrently, their commitment to the biosphere was highlighted by proactive ex-situ cultivation and reforestation efforts, which successfully raised the biodiversity index surrounding their massive Cikarang factory complex from 3.44 to 3.80. Waste management was also strictly categorized; in 2020, they efficiently processed and safely handed over 743.40 tonnes of B3 (Hazardous and Toxic) and non-B3 waste to certified third-party handlers.

Progressing into 2021, PT Kalbe Farma Tbk pivoted towards supply chain resilience by aggressively developing a local raw material ecosystem, most notably through their red ginger cultivation program. This initiative not only guaranteed raw material security during a period of global shipping crises but also empowered local agrarian networks. This was bolstered by intensive cross-sector collaborations with national universities to scientifically improve product efficacy. In 2022, the company achieved remarkable milestones in closed-loop systems. They explicitly optimized the use of recycled materials across secondary and tertiary packaging arrays, showcasing a definitive shift towards circular product design. Their transition to "Green Manufacturing" was accelerated through heavy capital investments in robotics, process automation, and systemic digitalization, drastically lowering their energy intensity per unit produced. A pivotal step in carbon footprint reduction was the introduction of an electric-powered fleet for urban product distribution. Quantitatively, PT Kalbe Farma successfully reduced highly dangerous B3 waste by 29.31 tons in 2022 compared to the previous year. Furthermore, their water management systems achieved phenomenal success;

wastewater volume at the Cikarang facility was slashed from a staggering 50,930 cubic meters in 2021 down to 36,666 cubic meters in 2022, highlighting world-class water conservation and effluent recycling practices.

Discussion and Implications

The extensive data acquired directly supports core circular economy theories (Geissdoerfer et al., 2017; Stahel, 2016), definitively proving that waste reduction, resource use maximization, and product lifecycle extensions can be successfully executed even within highly regulated, stress-tested environments like the medical device industry. Both PT Kimia Farma Tbk and PT Kalbe Farma Tbk have proven that integrating the eight CE determinants—most notably *Resource Management and Supply Chain*, *Business Models*, and *Technology and Infrastructure*—leads to massive operational and societal benefits.

The theoretical implications of this study strongly reinforce the conceptual argument that corporate sustainability is not inherently detrimental to profitability. Instead, as demonstrated by the OLIS program and Kalbe's green manufacturing overhauls, circular economic models inherently drive cost reductions through extreme resource efficiency while concurrently opening new, sustainable market opportunities. From a practical standpoint, the study implies that national healthcare manufacturing can completely decouple from linear, import-heavy models. However, this transition requires overcoming significant institutional challenges, including the necessity for deep organizational culture shifts, heavy initial capital expenditures for green technology, and the development of robust, specialized infrastructure for waste recovery. The findings clearly dictate that government engagement and the formulation of highly supportive, incentivized environmental policies are absolutely critical to facilitating a wider, industry-level transition.

While this qualitative study provides profound, contextualized insights into the strategies of two industry giants, it inherently holds methodological limitations regarding broad generalizability. Future empirical research is urgently required to expand upon these findings using rigorous quantitative methodologies. Scholars are highly encouraged to evaluate specific, standardized financial ratios extracted from corporate annual reports to empirically validate the economic efficiency of CE practices across the broader industry. Potential variables for future quantitative study include Asset Turnover Ratios (to measure the efficiency of sustainable asset utilization), Resource Efficiency Ratios, Net Profit Margins (factoring in environmental compliance costs), Return on Assets (ROA), Energy and Material Expenditure Ratios, and precise Waste Reduction and Material Reuse Ratios. Analyzing these metrics will provide an irrefutable mathematical foundation for the widespread adoption of the circular economy.

4. CONCLUSION

This study has meticulously and comprehensively examined the complex adoption and resulting impact of circular economy practices within the Indonesian medical device industry, specifically channeled through the qualitative lens of PT Kimia Farma Tbk and PT Kalbe Farma Tbk during the immensely challenging period of the COVID-19 pandemic. The extensive findings robustly underscore the significant, transformative potential of circular economy principles to exponentially enhance operational efficiencies, drastically reduce corporate environmental footprints, and foster highly resilient, sustainable business models. By actively implementing these regenerative strategies, both corporations have demonstrated highly notable, quantifiable improvements in hazardous waste management, localized resource efficiency, and advanced material reuse, thereby contributing profoundly to both national economic resilience and critical environmental stewardship. Furthermore, this research has vividly highlighted the absolutely critical role of continuous technological innovation, deep multi-stakeholder engagement, and the necessity of supportive regulatory frameworks in accelerating the national industrial transition towards a fully circular economy. The transition executed by these companies within the highly regulated medical device sector presents a highly promising, empirically proven pathway to achieving the United Nations' Sustainable Development Goals (SDGs). It not only offers a viable, profitable blueprint for decoupled economic growth and environmental protection but also sets a formidable operational precedent for other linear industries to rapidly follow. Ultimately, embracing circular economy principles is no longer merely an optional, alternative strategic choice for corporate public relations; rather, it has proven to

be an absolutely necessary, fundamental evolutionary step towards ensuring a resilient, self-sufficient, and regenerative industrial future.

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REFERENCES

- Blomsma, F., & Brennan, G. (2017). The emergence of circular economy: A new framing around prolonging resource productivity. *Journal of Industrial Ecology*, 21(3), 603-614.
- Burhanudin Akbar, B. M., & Putri, M. A. (2023). Medical Device Industry Development in Indonesia. *West Science Business and Management*, 1(03), 206-212.
- Denzin, N. K., & Lincoln, Y. S. (Eds.). (2017). *The SAGE Handbook of Qualitative Research* (5th ed.). SAGE Publications.
- Ellen MacArthur Foundation. (2013). *Towards the Circular Economy: Economic and business rationale for an accelerated transition*.
- Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hekkert, E. J. (2017). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757-768.
- Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A Review on Circular Economy: The Expected Transition to a Balanced Interplay of Environmental and Economic Systems. *Journal of Cleaner Production*, 114, 11-32.
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Conservation and Recycling*, 127, 221-232.
- Lewandowski, M. (2016). Designing the Business Models for Circular Economy—Towards the Conceptual Framework. *Sustainability*, 8(1), 43.
- Murray, A., Skene, K., & Haynes, K. (2017). The Circular Economy: An Interdisciplinary Exploration of the Concept and Application in a Global Context. *Journal of Business Ethics*, 140(3), 369-380.
- Patton, M. Q. (2014). *Qualitative Research & Evaluation Methods: Integrating Theory and Practice* (4th ed.). SAGE Publications.
- Ritzén, S., & Sandström, G. Ö. (2017). The Circular Economy and the Promise of Resilience in Industrial Systems. *Advances in Manufacturing*, 5(3), 359-366.
- Rizos, V., Behrens, A., Van Der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., ... & Topi, C. (2016). Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers. *Sustainability*, 8(11), 1212.
- Stahel, W. R. (2016). The Circular Economy. *Nature*, 531, 435-438.
- Tukker, A. (2015). Product services for a resource-efficient and circular economy – A review. *Journal of Cleaner Production*, 97, 76-91.
- Webster, K. (2017). *The Circular Economy: A Wealth of Flows*. Ellen MacArthur Foundation Publishing.
- Yuan, Z., Bi, J., & Moriguchi, Y. (2006). The Circular Economy: A New Development Strategy in China. *Journal of Industrial Ecology*, 10(1-2), 4-8.