

WASTE MANAGEMENT TRENDS TOWARD CIRCULAR ECONOMY



EDITORS
MUHAMMAD ARIF AB AZIZ
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Waste management has become a global challenge, significantly contributing to widespread pollution due to escalating waste generation. There is an urgent need to transition waste management strategies towards a circular economy. This insightful approach addresses key aspects such as waste minimisation, recycling and reuse, and resource recovery, highlighting the fiscal benefits involved.

This book delves into recent discoveries of advanced pollution reduction techniques, innovative waste conversion methods, and unique fabrication processes that are reshaping the field of waste management. Through detailed analysis and case studies, it offers a comprehensive understanding of how these progressive methods are paving the way toward a more sustainable future, emphasising the importance of adopting a circular economy model for effective waste management globally.

This book is a crucial resource for researchers, industry professionals, and government sectors, providing valuable insights to enhance decision-making in waste management.



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ECONOMY**

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PREFACE

The challenge of waste management has become a critical global issue, with escalating waste generation contributing significantly to various forms of pollution. To address this, transitioning to a circular economy for waste management presents a promising solution. This approach emphasises waste minimisation, recycling, and reuse, as well as resource recovery, which offer substantial fiscal benefits. Recent advancements in pollution reduction techniques, innovative waste conversion methods, and unique fabrication processes have further illuminated these aspects.

Malaysia's steadfast commitment to the 2030 Agenda, which aims to develop a sustainable environment and circular economy in alignment with the Sustainable Development Goals (SDGs), exemplifies its dedication to a greener future. The 2030 Agenda serves as a comprehensive roadmap, guiding Malaysia towards sustainability and promise.

This book, titled *Waste Management Trends Toward Circular Economy*, is a culmination of collective efforts and insights. We extend our heartfelt gratitude to all contributors who played a pivotal role in bringing this work to fruition. Their expertise and dedication have been instrumental in shaping this comprehensive resource.

Muhammad Arif Ab Aziz

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INTRODUCTION

The transition toward a circular economy (CE) marks a pivotal shift in addressing social, economic, and environmental sustainability. In waste management, a circular economy offers a comprehensive approach to maximising resource value by converting waste materials into value-added compounds. By implementing a CE, reliance on crude resources will be reduced, thereby mitigating environmental impacts.

This edited book, entitled *Waste Management Trends Toward Circular Economy*, gathers contemporary research and innovations that benefit waste management within the circular economy framework. It highlights how these advancements drive sustainable development by examining transformative methods for managing pharmaceutical compounds, carbon dioxide, wastewater, and plastic waste. This introduction provides context on the role of a circular economy in waste management, outlines the challenges and objectives shaping this book, and presents an overview of each chapter's contributions to the theme.

The general concept of the CE is often depicted through the activities of “reduce, reuse, recycle” which promote a restorative and regenerative approach that contrasts with the traditional “take-make-dispose” model of the linear economy. The term “take-make-dispose” refers to the linear economy, which consists of the typical practices of (1) Resource extraction, (2) Product creation, and (3) Disposal after use. However, the current definition of CE has been further refined to primarily focus on economic prosperity, followed by environmental quality, social equity, and impacts on future generations.

By integrating waste management with the CE model, a transformative opportunity arises where waste generated is redefined as

a resource, converting it into new products or energy. Thus, the intercorrelation of CE with waste management fosters long-term economic and environmental benefits.

A continuously growing volume of waste, driven by rapid industrialisation, urbanisation, and increased consumer demand, has placed a considerable burden on current waste management systems. This includes air pollution from carbon dioxide (CO₂) emissions, water pollution from hazardous materials such as pharmaceutical compounds, and soil pollution from non-biodegradable plastic waste. The air and water pollution from these substances is a serious problem that needs attention because it can cause long-term damage to the environment and harm people's health. These challenges reveal the flaws of traditional linear economy waste management systems and emphasise the necessary pathways needed to effectively manage waste through circular and innovative strategies.

The main objective of this book is to present progressive waste management practices aligned with CE principles, promoting both environmental sustainability and economic viability. It adopts a comprehensive approach that includes the removal of pharmaceutical compounds and CO₂ through adsorption technologies, followed by the reuse of wastes such as CO₂ and plastics to create valuable products. Each chapter highlights the specific implementation of CE concepts in waste management. The book covers both emerging trends and established technologies, providing a thorough overview of the field.

Waste Management Trends Toward Circular Economy covers six chapters devoted to innovative strategies and advanced technologies focusing on waste management, resource transformation, recycling, and environmentally friendly strategies. Chapter 1 considers the removal of pharmaceutical contaminants from water using adsorbent materials. Chapter 2 presents strategies for CO₂ capture through its adsorption, with a specific focus on carbon-based adsorbent materials. Chapter 3 offers the reconstruction of wastewater into valuable byproducts, showcasing its potential to contribute to environmental preservation.

Chapter 4 explores the catalytic conversion of CO₂ to methane (CH₄). Chapters 5 and 6 focus on plastic-waste management, detailing methods for repurposing plastic waste into construction materials and for energy recovery via controlled incineration. Collectively, these approaches highlight the significant potential to reduce plastic waste.

Each chapter in this book shows a dedication to managing waste in a sustainable way, highlighting new ideas that support the circular economy and promote saving resources, protecting the environment, and reducing waste.

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