International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133, Print ISSN: 2664-7125
Received: 06-10-2025, Accepted: 05-11-2025, Published: 21-11-2025
Volume 7, Issue 4, 2025, Page No. 196-201

Circular economy and waste-to-energy: Pathways to sustainable resource management

Akshay Chavan[1*], Kishor Shinde[2], Santosh Kale[3]
[1] Department of Environmental Science, School of Earth Science, Punyashlok Ahilyadevi Holkar Solapur University, Solapur, Maharashtra, India
[2] Department of Zoology, Walchand College of Arts and Science, Solapur, Maharashtra, India
[3] Department of Economics, School of Social Sciences, Punyashlok Ahilyadevi Holkar Solapur University, Solapur, Maharashtra, India

Abstract

The circular economy and waste-to-energy (WTE) technologies provide critical pathways for sustainable resource management by reducing landfill dependency, improving resource efficiency, and promoting renewable energy generation. Circular economy principles prioritize the reuse, recovery, and valorization of materials to maintain resource value and minimize environmental impacts. Waste-to-energy technologies—including incineration, gasification, pyrolysis, and anaerobic digestion—enable the transformation of residual waste into energy and nutrient-rich byproducts, thereby supporting sustainable urban waste management and climate goals. While WTE technologies present economic, environmental, and social benefits, challenges such as high capital costs, technological limitations, policy barriers, and public acceptance must be addressed to ensure long-term viability. Case studies from Vienna, Bangladesh, and Southeast Asia demonstrate the potential of integrating WTE within circular economy frameworks to enhance energy security, reduce greenhouse gas emissions, and optimize resource utilization. Overall, the convergence of circular economy strategies and WTE solutions offers a holistic approach to sustainable development and long-term resource resilience.

Keywords: Circular economy, waste-to-energy, resource management, sustainability, anaerobic digestion, renewable energy, waste valorization, material recovery, environmental performance, urban waste management

Introduction

Regular exercise eases depression and anxiety; it is that simple. It has the power to improve our mood, sharpen our thinking processes, and facilitate the release of hormones and endorphins that trigger a feeling of happiness. For this reason, all health professionals, especially clinical psychologists, encourage their patients to exercise for therapeutic purposes. Physical activity is defined as any activity that causes the body to undergo physiological changes and engages the musculoskeletal system and energy systems. Meanwhile, exercise is a subcategory of physical activity that involves planned, structured, and repetitive bodily movements performed for the purpose of at least one part of the body. The objective of this article is to examine the key elements of "how exercise impacts mental health" and to provide a general overview of the way exercise strategies and programs are formulated within a specific context. Consequently, covered topics will include the importance of physical activity for well-being, the possible frontal lobe processing control of physical activity, and how exercise activates sensations in the body. Regular exercise eases depression and anxiety; it is that simple. It has the power to improve our mood, sharpen our thinking processes, and facilitate the release of hormones and endorphins that trigger a feeling of happiness. For this reason, all health professionals, especially clinical psychologists, encourage their patients to exercise for therapeutic purposes. Physical activity is defined as any activity that causes the body to undergo physiological changes and engages the musculoskeletal system and energy systems. Meanwhile, exercise is a subcategory of physical activity that involves planned, structured, and repetitive bodily movements performed for the purpose of at least one part of the body. The objective of this article is to examine the key elements of "how exercise impacts mental health" and to provide a general overview of the way exercise strategies and programs are formulated within a specific context. Consequently, covered topics will include the importance of physical activity for well-being, the possible frontal lobe processing control of physical activity, and how exercise activates sensations in the body.

Circular Economy Principles

The circular economy model's core principles cover strategies that ensure resource efficiency and waste reduction by putting in place and reimagining new approaches in production and consumption systems to traditionally consider waste as an asset and resource rather than a guilty consequence of an industry process. Industries can devise a holistic strategy, given the principles of a circular economy at play, to waste management practices such as recycling, resource recovery, or upcycling and ensure environmental responsibility along with retaining the value of material (Reddy *et al*., 2023) [10]. Innovative solutions' best practices, particularly in recently analyzed oil and gas industries, practice the waste stream optimization when components of residual waste, such as spent catalysts or produced water, can be recovered and introduced to existing production chains, contributing to sustainability goals (Digitemie *et al*., 2025) [4]. Complementary effort in public-private partnerships, regulations, and further education promote the businesses and industries shift towards economically sustainable results yet alongside sustainability goals. The core principles define a path for technological solutions integration with waste-to-energy systems as part of circular economy milestones that transfer residual waste into another valuable resource and complete critical loops of resource flows.

Moreover, circular economy mechanisms define a wide array of measures for minimizing waste production and improving employed resources at the production and consumption cycle. In particular, efficient practices may include the installation of advanced sorting and material recovery facilities that allow for the recovery of reusable materials from mixed waste fractions (Shah *et al*., 2024) [13]. The selective application of composting and anaerobic digestion can allow further recovery of organic waste fraction into energy and nutrient products, thus supporting the values of the regenerative resources agenda. The cross-sector analysis suggests that these solutions improve the resource efficiency and support the waste-minimizing agenda acknowledged in systematic reviews on industrial practices (Aithal & Aithal, 2023) [1]. Consequently, with regard to the comprehensive approach provided by the circular economy, resource management practices prioritize material recovery, composting, and energy production as solutions for maximizing resource value and addressing waste accumulation issues.

A specific example of translating circular economy concepts to practice is found in the oil and gas industry. In this case, the industry was encountering significant scientific, economic, and environmental challenges. Circular waste optimization practices, such as produced water recovery and recycling and spent catalyst recycling, made it possible to mitigate the threats (Digitemie *et al*., 2025) [4]. The implementation of renewable energy sources has also reinforced oil and gas waste management practices. In this case, collaboration between operators, researchers, and policymakers was critical in advancing current circular practices and establishing regulatory support for the further development of technological advancements. Global concepts such as the circular economy model can be effectively implemented in specific industrial realities to serve the industry's sustainable needs and respond to growing threats to the world's ecosystem.

Waste-to-Energy Technologies

Waste-to-energy (WTE) refers to a broad class of technologies that can help extract useful energy (electricity, heat, fuels, etc.) from a range of waste materials (Khan & Kabir, 2020) [7]. These technologies include incineration, gasification, pyrolysis, and anaerobic digestion, among others. Each differs from one another in terms of technical approach, energy efficiency, and environmental implications. The anaerobic digestion of organic waste streams (such as food or agricultural waste) is often considered the most sustainable WTE technology as it can yield renewable electricity with relatively lower environmental impacts. In terms of WTE systems, emerging technologies sport features like artificial intelligence, enhanced filtration systems, and renewable energy. The focus is on making such systems more efficient, scalable, and with lesser greenhouse gas emissions (Okuh *et al*., 2023) [9]. Such WTE technologies help strengthen sustainable waste management and circular economy objectives as they reduce landfill reliance and residual wastes can be transformed into energy resources.

In addition, the different waste-to-energy technologies also have unique performance and sustainability characteristics that determine their applicability for certain cases. The most common and popular technology is incineration, which combusts the municipal solid waste to generate energy and electricity. However, it has low sustainability due to the gaseous and solid emissions released into the environment, including toxic ones such as dioxins and furans (Khan & Kabir, 2020) [7]. Gasification and pyrolysis are similarly thermochemical waste-to-energy technologies that transform waste into syngas and bio-oil, with gradually improving sustainability performance compared to incineration. Among the waste-to-energy technologies, anaerobic digestion is viewed as one of the most sustainable solutions, primarily because it is a biological process that breaks down organic waste to generate biogas and high-value nutrient digestate. Furthermore, anaerobic digestion has proven beneficial for establishing small and medium enterprises under the circular economy (Hussain *et al*., 2020) [6]. Therefore, the emerging differences in technological processes prompt the stakeholders to adopt a suitable waste-to-energy system according to the resource characteristics, environmental needs, and socioeconomic initiatives.

Hence, waste-to-energy is a technology that contributes to landfill diversion by recovering valuable energy and materials from non-recyclable wastes through thermal and biological processes. These practices reduce the reliance on landfilling as a disposal option (Van Caneghem *et al*., 2019) [16]. Studies analyzing the solid waste treatment scenarios, revealed that waste-to-energy systems possible options like material recovery facilities combined with composting and anaerobic digestion had less environmental impacts compared to linear systems relying on landfills (Shah *et al*., 2024) [13]. Besides recycling, waste-to-energy solutions reduce valuable resources extraction and mitigate the overflow of detrimental materials by containing and further using the waste streams. Waste-to-energy technologies do not conflict with recycling practices, but rather aid the circular economy efforts to minimize resource loss, promote sustainable practices, minimize environmental damage.

Integration of Waste-to-Energy in Circular Economy

Waste-to-energy is proposed to work within the circular economy as stakeholders would like to keep residual waste streams that cannot be recycled in the traditional manner in the circular economy for as long as possible. With the use of waste-to-energy technologies, energy and material value can be derived from these unrecyclables to keep them productive in the economy as opposed to sending them to a landfill (Van Caneghem *et al*., 2019) [16]. At the same time, process control advancements and carbon capture technologies have been deemed necessary measures to ensure waste-to-energy technology stays aligned with carbon neutrality and circularity goals (Dal Pozzo *et al*., 2023) [3]. Optimized flue gas cleaning, advanced process engineering, and further technological development can assist in the circular economy's ambitions for the environment due to the potential for less harmful emissions and byproducts. As such, waste-to-energy technology aids not only in recycling waste but also the policies of the circular economy regarding successful and indefinite resource management, as well as a focus on climate and sustainability during activity across various industries and municipalities.

Finally, the waste-to-energy technologies are integrated in the circular economy solutions providing significant gains in environmental and operational performance. The waste-to-energy systems are able transform residual waste, which cannot be recycled, into energy allowing to avoid landfilling while continuing looping of materials and energy throughout the economic processes. The results of multiple life cycle assessment studies show that potential environmental impacts of combining composting and material recovery operations along with waste-to-energy are lower than those of landfilling, which is the main waste disposal option (Shah *et al*., 2024) [13]. With each of the individual practices targeted at resource conservation by creating value at different stages while contributing to municipal's sustainability goals through strengthened waste management facilities and reduced GHG emissions, the complementary nature of coupling these practices serves to enhance waste transformation means of circular economy outcomes in their space as a whole.

Notwithstanding these benefits, the application of waste-to-energy facilities in circular economy models posits a number of significant challenges, which may hinder their application in practice. The relatively higher upfront capital investment and sustained operational and maintenance costs may curtail the feasibility of implementing the technologies in waste-to-energy applications, especially, in economically divergent urban centers (Haraguchi *et al*., 2019) [5]. Above all, regulatory concerns such as meeting emission control targets may complicate the implementation of waste treatment facilities due to the costly adoption of additional or alternative technologies. Highly variable waste composition (from waste source-to-source) and declining project revenues due to policy change can undermine the longstanding technical and financial feasibility of waste-to-energy projects as demonstrated in multi-national case studies employing stochastic models (Haraguchi *et al*., 2019) [5]. To articulate, given the relatively low percentage of city-wide energy demands originating from waste-to-energy facilities, challenges in investing and constructing additional facilities may be overcome through investment and regulatory policies aimed at perturbation through conventional circular economy models.

Benefits of Waste-to-Energy Solutions

Importantly, the proposed waste-to-energy technologies contribute to the sustainability of resources through economic and environmental benefits that reverse resource depletion and resource poverty. In many Southeast Asian countries, waste-to-energy development has reduced reliance on landfilling, reducing associated greenhouse gas emissions and land utilization for garbage disposal (Tun *et al*., 2020) [15]. While converting municipal solid waste streams into renewable electricity, the plants provide extra income through energy sales and possible gate fees proposed in certain countries that ensure financial sustainability (Nassar *et al*., 2025) [8]. Besides, the efficient incorporation of waste-to-energy processes in an integrated waste management system studied in Egypt will strengthen regulatory adherence and institutional work efficiency, facilitate employment opportunities, and secure technological progress. The environmental progress, energy, and new income streams from residual waste streams position the proposed technologies as effective tools in embedding the sustainable development agenda in both developing and developed countries.

Moreover, waste-to-energy technologies have proved to be effective to a vast extent for greenhouse gas abatement as these technologies convert the waste streams into energy forms that can be utilized. The organic and non-recyclable fractions of waste released from the waste-to-energy technologies help in avoiding the release of methane from landfills, a major contributor to atmospheric methane in case of traditional disposal methods (Rezania *et al*., 2023) [11]. Incorporation of technologies such artificial intelligence, efficient filtration and renewable energy at waste-to-energy plants improves the efficiency of processes employed and improves the performance of the plant in trapping dangerous gases during the energy transformation process (Okuh *et al*., 2023) [9]. Further, the supportive policies and regulations enlist the greenhouse gas reductions achievable through waste-to-energy technologies as common denominator to various ambitions relating to waste management or climate goals. They also support the operations entrusted with such technologies to encourage behavioral changes that help them achieve both waste-to-energy and climate-related objectives. These elements taken collectively present waste-to-energy as a central aspect for national and municipal agendas that crop up to improve total emissions from gaseous emissions on the one hand while moving towards ideal resource management on the other.

At the same time, the development of waste-to-energy infrastructure also provides significant economic impacts adaptable at local and national scales. The roll-out of waste-to-energy technologies is directly linked with job creation, especially during the construction, operation, and maintenance phases that are critical for generating employment within urban and peri-urban communities (Rogoff & Screve, 2019) [12]. These facilities directly support energy diversification as they produce electricity and heat from the processing of municipal solid waste and local authorities can use them to help stabilize or lower energy prices for local clients and businesses severely affected by rising fossil fuel prices or prone to disruptions due to unstable energy grids (Tun *et al*., 2020) [15]. The financial appeal of waste-to-energy mechanisms also derives from the revenues associated with energy distribution sales and, potentially, the gate fees channels from waste generators, which offer additional financial security to local authorities and operators. Beyond workforce development and energy savings, waste-to-energy solutions promote the economic development objectives of local authorities through its waste infrastructure systems that support sustainable resource management frameworks.

Currently the technology and process of waste-to-energy faces a lot of challenges as listed below.

While waste-to-energy technologies offer significant benefits to their users, several barriers have been identified to undermine the viable opportunities for solutions by stakeholders in the framework of circular economy development and deployment. Stakeholders in small and medium enterprises (SMEs) - one of the prevalent actors implementing the solutions like anaerobic digestion - continue to struggle with technological challenges and value seepage within the operational value chain (Hussain *et al*., 2020) [6]. Key aspects involve the losses related to byproducts' collection, the enhanced need for processes' optimization, and innovation requirements to guarantee competitive advantage and long-term viability. In addition, to achieve zero waste to landfill, stakeholders' involvement demands not only significant funds but also the ability to adapt amid regulatory challenges and market dynamics. Therefore, SMEs in the waste sector should be ready to address the barriers directly associated with the technological and economical aspects to maximize the reusable value of natural resources and optimize the environmental benefits of waste-to-energy in the circular economy context.

As an illustration of this trend, technological challenges linked with waste-to-energy projects lie primarily in the areas of processing efficiency and scale with significant implications for the technology to permeate existing models. Evidence from urban settings shows that, while advanced thermochemical processes are applicable, they tend to only cover a fraction of a city's energy demands and, as such, energy targets remain limited (Haraguchi *et al*., 2019) [5]. The fluctuation of input composition also implies the constant recalibration of technological setups to ensure estimated conversion efficiencies. Additionally, quantitative modeling assessments further reveal how uncertainties in future settings as well as impending policy adjustments manifest complex optimizations to be undertaken in terms of both scale and performance (Haraguchi *et al*., 2019) [5]. These obstacles to providing a certain level of scale and predictability in operations in waste-to-s energy systems point out the need for further dedication of effort in the areas of research, technology innovations, and the implementation of flexible procedures for waste-to-energy facilities to enhance scalability as part of the circular economy.

Moreover, social and political barriers appear to have significant impact on the overall feasibility and social acceptability of waste-to-energy alternatives to promote circularity. Concern from communities about the environmental and health implications, air pollutants, and the siting of incineration plants have resulted in a high level of opposition to the deployment of these technologies in many jurisdictions, making their approval and development hurdles (Tsui & Wong, 2019) [14]. On a policy layer, heterogeneity in the regulatory framework and the absence of definitive guidelines on the choice of technologies and environmental legislations can further inhibit progress. The situation could be direr due to competing narratives associated with the perceived risks and benefits of different waste-to-energy strategies, which translate into divisive public debate and reluctance among decision-makers. Engaging with various stakeholders, communicating risks in a transparent manner, and establishing policy guidelines that consider all groups in society are essential to overcoming these challenges by achieving social license and institutional support for waste-to-energy strategies (Tsui & Wong, 2019) [14].

Challenges in Waste-to-Energy Implementation

On the practical application of waste-to-energy systems, several case studies suggest the measurable benefits of such projects in the sustainability agenda in the context of urbanization. For instance, in the case of Chittagong City, Bangladesh, a project evaluation revealed that anaerobic digestion was the best technology for municipal solid waste management. This was due to the technology's fit with technical, economic, and social conditions specified by the stakeholders (Alam *et al*., 2022) [2]. With the implementation of the technology, the country was able to justify its progress in the Sustainable Development Goals in the aspects of reducing waste in the landfills and generating renewable energy and resource recovery from waste. The authors suggest that this project is similar to other technologies in different locations where site-specific factors such as regulations, standards, and economic considerations were taken into account during planning and implementation for long-term operational and efficiency (Rogoff & Screve, 2019) [12]. The results of these studies demonstrate that there is a vast variety of applications for waste-to-energy technologies that are capable of addressing environmental, economic, and institutional issues in line with the targets of sustainable development.

One notable example highlighted is Vienna's waste-to-energy plant, which has attracted global attention for its circular economy initiatives. The Spittelau facility, integrating advanced incineration technology with district heating, minimizes waste and supplies renewable heating to thousands of homes. Life cycle assessments confirm that the facility's operations offer reduced environmental impacts over traditional waste management through lower greenhouse gas emissions and enhanced resource recovery (Shah *et al*., 2024) [13]. Success factors also include coordinated municipal policy, strong engineering and continued community communication that align operations with sustainability goals. The Vienna example shows the potential of waste-to-energy facilities, as part of circular economy initiatives, to effectively deliver environmental, operational and societal benefits in support of sustainable resource management.

Likewise, an extensive case study from Asia provides insight into the success and remaining challenges regarding the establishment of waste-to-energy systems. In several fast-growing economies, the increasing pressure to divert waste from landfills and the shortage of resources have driven local governments to adopt incineration and anaerobic digestion as the main technologies to be integrated into the urban waste management plans. For instance, policymakers and stakeholders from these countries continue to favor waste-to-energy systems to divert escalating waste generation, recently underpinning the circular economy initiatives on self-sufficient energy and improved resource recovery to reduce environmental pollution (Rezania *et al*., 2023) [11]. The results from these projects have shown advances in cost-effectiveness and sustainability, while local governments clarified the leading role for collaborative governance and flexible regulations. Even so, challenges still exist that include a lack of technological innovation, financing opportunities, and improved institutional partnerships to secure the sustainable development of waste-to-energy integration (Rezania *et al*., 2023) [11].

Impact on Sustainability and Resource Efficiency

Waste-to-energy technologies have a significant role to play from a sustainability point of view, contributing to improved environmental performance as well as resource efficiency. The systems enable recovery of waste material from landfills by providing energy from renewable resources as well as recovering the nutrients from it, especially through anaerobic digestion, which produces biogas as well as compost (Hussain *et al*., 2020) [6]. As for municipal solid waste management, case studies such as Chittagong City highlight how the selection of the optimal waste-to-energy technology must consider and integrate several technical, economic, environmental, and social aspects to help the progression of overall sustainable development (Alam *et al*., 2022) [2]. Finally, the continued pursuit of technological advancement in small and medium-sized enterprises is paramount in helping to recover additional value from waste stream resources in comparison to the losses incurred through more traditional approaches, and the further application of such technologies in circular economy networks can help to provide an uplift in resource efficiency while progressing towards zero waste and cleaner production initiatives.

Furthermore, the introduction of waste-to-energy technologies has been shown to impact quantitatively the overall efficiency of resources utilization across industry practices. The reduction of virgin resources consumption as well as landfilling residuals achieved through the recovery of the energy from non-recyclable wastes is allowing these systems to optimize the materials' exploitation. While comprehensive literature reviews confirm this evidence supporting the mechanisms behind their implementation in the circular economy and their commitment to waste generation reduction and resources efficiency and innovation maximization (Aithal & Aithal, 2023) [1], that is putting the emphasis on the efficiency of circulation of materials and energy. Waste-to-energy solutions and systems contribute to the circle of the economy's circle target through the processes ensuring waste-to-energy derivation complement to recycling and recovery of materials' processes (Aithal & Aithal, 2023) [1].

In conclusion, the inclusion of waste-to-energy technologies within the circular economy can improve the long-term sustainability through a more resilient and dynamic transition to the circular economy timeline for a ditched waste-to-energy technology. In the long-term timeline, the technology can integrate not only a diverted waste-to-landfill benefit, but also open opportunities for circularity through resource recovery and renewable energy production, resulting in benefits for the ecosystem. The long-term achieved benefits are derived from the continuation of institutional reforms, establishment of an integrated waste management system that align both regulatory and operational aspects to further the ideas of a sustained circularity (Nassar *et al*., 2025) [8]. Furthermore, through the sectoral analysis, the inclusion of certain aspects such as well thought-out revenue mechanism — e.g., gate fee adaptations — can bring forth financial resiliency and the ability to flourish waste-to-energy systems in a changing policy landscape. With a continued, system-wide approach, the waste-to-energy technologies can shift the economic paradigm from waste economy to a sustainable, resource-based economy with a circular approach (Nassar *et al*., 2025) [8].

Conclusion

Integrating waste-to-energy technologies within circular economy frameworks offers a robust strategy for sustainable resource management, addressing both environmental and economic objectives. WTE systems transform non-recyclable waste into energy and valuable byproducts, reducing landfill reliance, greenhouse gas emissions, and resource depletion. Case studies demonstrate that successful implementation requires technological optimization, regulatory support, stakeholder engagement, and public acceptance. While challenges such as high costs, fluctuating waste composition, and social opposition persist, coordinated efforts across policy, industry, and community levels can enhance the feasibility and effectiveness of these systems. Ultimately, the synergy between circular economy principles and waste-to-energy technologies promotes a resilient, resource-efficient, and low-carbon future, advancing the broader goals of sustainable development and responsible consumption.

References

1. Aithal S, Aithal PS. Importance of circular economy for resource optimization in various industry sectors–A review-based opportunity analysis. International Journal of Applied Engineering and Management Letters (IJAEML),2023:7(2):191–215. https://doi.org/10.2139/ssrn.4575631
2. Alam S, Rahman KS, Rokonuzzaman M, Salam PA, Miah MS, Das N, *et al*. Selection of waste to energy technologies for municipal solid waste management—towards achieving sustainable development goals. Sustainability,2022:14(19):11913. https://doi.org/10.3390/su141911913
3. Dal Pozzo A, Lucquiaud M, De Greef J. Research and innovation needs for the waste-to-energy sector towards a net-zero circular economy. Mdpi.Com,2023:16(4):1909. https://doi.org/10.3390/en16041909
4. Digitemie WN, Onyeke FO, Adewoyin MA, Dienagha IN. Implementing circular economy principles in oil and gas: addressing waste management and resource reuse for sustainable operations. International Journal of Multidisciplinary Research and Growth Evaluation,2025:06(01):99–104. https://doi.org/10.54660/.IJMRGE.2025.6.1.99-104
5. Haraguchi M, Siddiqi A, Narayanamurti V. Stochastic cost-benefit analysis of urban waste-to-energy systems. Journal of Cleaner Production,2019:224:751–765. https://doi.org/https://doi.org/10.1016/j.jclepro.2019.03.099
6. Hussain Z, Mishra J, Vanacore E. Waste to energy and circular economy: the case of anaerobic digestion. Journal of Enterprise Information Management,2020:33(4):817–838. https://doi.org/10.1108/JEIM-02-2019-0049
7. Khan I, Kabir Z. Waste-to-energy generation technologies and the developing economies: A multi-criteria analysis for sustainability assessment. Renewable Energy,2020:150:320–333. https://doi.org/https://doi.org/10.1016/j.renene.2019.12.132
8. Nassar H, Biltagy M, Safwat AM. The role of waste-to-energy in waste management in Egypt: A techno-economic analysis. Review of Economics and Political Science,2025:10(2):151–167. https://doi.org/10.1108/REPS-09-2022-0062
9. Okuh CO, Nwulu EO, Ogu E, Egbumokei PI, Dienagha IN, Digitemie WN, *et al*. Advancing a waste-to-energy model to reduce environmental impact and promote sustainability in energy operations.

Allmultidisciplinaryjournal.Com,2023:04(01):885–891. https://doi.org/https://doi.org/10.54660/.IJMRGE.2023.4.1.885-891

10. Reddy VV, Kumar P, Rao ALN, Kumar R, Singh S, Asha V, *et al*. Waste to wealth generation: Innovative methodologies in resource utilization and minimization in circular economy. E3s-Conferences.Org,2023:453:01035. https://doi.org/10.1051/e3sconf/202345301035
11. Rezania S, Oryani B, Nasrollahi VR, Darajeh N, Lotfi Ghahroud M, Mehranzamir K, *et al*. Review on waste-to-energy approaches toward a circular economy in developed and developing countries. Mdpi.Com,2023:11(9):2566. https://doi.org/10.3390/pr11092566
12. Rogoff MJ, Screve F. Waste-to-energy: technologies and project implementation. In books.google.com. Publisher, 2019. https://books.google.com/books?hl=en&lr=&id=wmOMDwAAQBAJ&oi=fnd&pg=PP1&dq=successful+waste-to-energy+projects+sustainability+impacts&ots=rUgikFVQaV&sig=YSknSNdg563ARwGXG8dx8E631rA
13. Shah HH, Amin M, Pepe F, Tregambi C. Sustainable waste management and waste-to-energy in the context of a circular economy through various waste management technologies. Environmental Science and Pollution Research, 2024. https://doi.org/10.1007/s11356-024-33223-y
14. Tsui T-H, Wong JWC. A critical review: emerging bioeconomy and waste-to-energy technologies for sustainable municipal solid waste management. Waste Disposal Sustainable Energy,2019:1:151–167. https://doi.org/10.1007/s42768-019-00013-z
15. Tun MM, Palacky P, Juchelkova D, Síťař V. Renewable waste-to-energy in southeast Asia: Status, challenges, opportunities, and selection of waste-to-energy technologies. Mdpi.Com, 2020, 10(20). https://doi.org/10.3390/app10207312
16. Van Caneghem J, Van Acker K, De Greef J, Wauters G, Vandecasteele C. Waste-to-energy is compatible and complementary with recycling in the circular economy. Clean Technologies and Environmental Policy,2019:21:925–939. https://doi.org/10.1007/s10098-019-01686-0