

Trash to Transformer: Advancing Waste-to-Energy Systems for Decentralized Power Generation and Emission Mitigation

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Abstract: *The conversion of waste materials into electricity through waste-to-energy (WTE) systems presents a dual solution to global waste management challenges and sustainable energy demands. This study explores thermal WTE methodologies, emphasizing incineration-based electricity generation. The process involves waste collection, preprocessing, combustion in a high-temperature chamber (850–1200°C), energy recovery via steam turbines or thermoelectric generators (TEGs), and rigorous emission control. A functional model demonstrates the conversion of heat from combusted waste (plastics, paper, rubber) into electricity, stored in 12V batteries for practical use. Advanced filtration systems mitigate environmental impacts by reducing CO₂ and particulate emissions. Results confirm the viability of small-scale WTE systems, particularly for rural or off-grid applications, with integrated circuits enhancing reliability. This work underscores WTE's potential to reduce landfill dependency, lower greenhouse gas emissions, and provide decentralized energy solutions, supported by ongoing advancements in efficiency and emission control technologies.*

Keywords: waste-to-energy

