

Decadal Progress of Biomass and Waste-to-Energy in India's Energy Transition

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Abstract

Biomass and waste-to-energy (WtE) technologies play a significant role in India's renewable energy transition by providing dispatchable power while simultaneously addressing waste-management and environmental challenges. This study examines the decadal progress of biomass and WtE development in India from 2014 to 2023 using secondary data analysis, policy review, and literature synthesis. The analysis evaluates installed capacity growth, regional distribution patterns, policy interventions, and major constraints affecting sectoral expansion. The findings indicate that installed capacity increased from 8,181 MW in 2014 to 10,872 MW in 2023, representing a compound annual growth rate of approximately 3.2 percent. Maharashtra, Uttar Pradesh, Tamil Nadu, and Karnataka emerged as the leading contributors due to strong agro-industrial linkages and feedstock availability. The study further identifies government incentives, feed-in tariffs, and waste-management initiatives as important growth drivers, while feedstock supply volatility, inadequate waste segregation, high operational costs, and competition from low-cost solar power remain key barriers. Despite these challenges, biomass and WtE technologies continue to support grid stability, carbon-emission reduction, rural employment generation, and circular-economy objectives. The study concludes that improved feedstock management systems, supportive tariff mechanisms, and hybrid biomass-solar integration will strengthen the contribution of biomass and WtE technologies toward India's renewable-energy transition and net-zero 2070 targets.

Keywords

Biomass energy, Circular economy, Energy policy, Renewable energy transition, Waste-to-energy.