RETASTE Conference Abstracts
RETASTE-ANA-1299-In-person Poster
Rethymno, September 16-18, 2026
© Author(s) 2026 CC BY 4.0 License
DOI:10.5281/zenodo.23678276

Food Waste as a Strategic Substrate for Agricultural Biogas Production: Quantifying Energy and Climate Potential in Poland

Sylwia Łaba

Institute of Environmental Protection – National Research Institute (IOŚ-PIB), Słowicza 32, 02-170 Warsaw, Poland

ACCEPTED

Abstract

The integration of food waste valorisation with renewable energy production represents a strategic opportunity within the European Green Deal and circular economy framework. Poland generates over 4.5 million tonnes of food waste annually (EUROSTAT, 2024), while its agricultural biogas sector remains significantly underdeveloped relative to technical potential. This study quantifies the potential contribution of food waste to agricultural biogas production and assesses its environmental implications. The analysis covers 2022–2023 and combines national food waste reporting data, biogas production statistics from the National Support Centre for Agriculture (KOWR, 2024), and peer-reviewed methane yield coefficients for different substrate categories. The methodological procedure included: (i) determination of food waste mass at each stage of the agri-food chain, (ii) estimation of organic dry matter (oDM) content based on literature values, and (iii) calculation of theoretical biogas yields using substrate-specific methane production coefficients (m^3/t oDM). Additionally, a SWOT analysis was conducted to evaluate technological, regulatory and economic factors influencing implementation. Results indicate that the total theoretical biogas potential from food waste in Poland amounts to approximately 484 million m^3/year, corresponding to 72% of the current national agricultural biogas production capacity (672 million m^3/year). Food waste originating specifically from primary production and processing could yield approximately 228 million m^3/year (34% of total capacity). These findings demonstrate that food waste constitutes a major, yet underutilised, renewable substrate capable of substantially increasing biomethane output. Environmental assessment confirms that anaerobic digestion of food waste significantly reduces methane emissions compared to landfill disposal and enables nutrient recovery through digestate application, contributing to closed-loop nutrient cycles. However, barriers include administrative complexity, sanitary regulations for animal-origin substrates, grid connection limitations, and competition with other renewable energy technologies. The study concludes that food waste-based biogas production should be framed primarily as an environmentally sound waste management solution aligned with the waste hierarchy, with energy generation as a co-benefit. Policy coherence between food waste prevention strategies and renewable energy support mechanisms is essential to unlock this potential and maximise climate mitigation benefits.

Keywords: food waste, biogas, circular economy, methane reduction, renewable energy

References

References EUROSTAT, 2024. Food waste and food waste prevention by NACE Rev. 2 activity – tonnes

of fresh mass. European Commission.

KOWR, 2024. Agricultural biogas production statistics in Poland. National Support Centre for Agriculture.

Meyer, T., Edwards, E.A., Smith, A.L., 2020. Anaerobic digestion of food waste: current status and future perspectives. Bioresource Technology, 298, 122551.

Fagerström, A., Al Seadi, T., Rasi, S., Briseid, T., 2018. Biogas production from food waste – energy recovery and climate impact. Waste Management, 71, p.506–517.

ACCEPTED