

Identifying Optimal Location for New Biogas Plants by Livestock Waste Biomass to Support Evidence-based Energy Policy: A Case Study in the Alps

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Abstract Bioenergy production, particularly from livestock waste, plays a crucial role in realistic deep decarbonization pathways toward a circular energy system. The Alpine region offers significant potential in this context due to the widespread availability of biomass resources, both animal and vegetal.

This study identifies optimal locations for new biogas plants utilizing livestock waste biomass in South Tyrol (Italy), through a comprehensive spatially explicit assessment. The proposed framework considers both enabling and constraining land-use-related factors, including proximity to urban areas, transport and energy infrastructure, legal and ecological restrictions (e.g., water bodies, protected natural areas, slope gradients), and the distribution of biomass feedstock. To embed these critical components into the decision-making process, the methodology combines a multi-criteria analysis with an optimization algorithm to identify and rank potential suitable locations based on supply chain efficiency and logistical feasibility, particularly minimizing transportation distances/costs.

The resulting scenarios facilitates a comprehensive evaluation of competing priorities to support evidence-based energy policy and unveils the importance of spatial modelling in the decarbonization process, addressing economic, environmental and social challenges to reconcile energy goals with territorial sustainability.