Developing and Installing the LIFE-W2B Facility

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Keywords: anaerobic digestion, gasification, solar drying, biomethane
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The LIFE-W2B project aims to develop an integrated waste-to-bioenergy demonstration facility at the All4Waste Technological and Innovation Park of the Hellenic Mediterranean University (HMU), supporting the transition towards circular and sustainable waste management systems. The facility is designed to integrate existing infrastructures with newly developed technological components into a multidisciplinary platform capable of processing approximately 1,000 tonnes of waste annually and converting them into high-value products such as biomethane and biochar.

The existing infrastructure includes two solar drying cells (100 m² each) with bridge mixing systems and subfloor heating, a heat pump and solar thermal panels, an autonomous composting unit (12 m³) with a treatment capacity of 150 t/year, two solid-state anaerobic digestion reactors (3 m³ each), two wet anaerobic digestion reactors (1 m³ each), and three advanced greenhouses (160 m² each) able to utilize heat and CO_2 from the system. These facilities are located within a 10,000 m² licensed plot equipped with power, water and communication networks.

The new components include a 10 m³ anaerobic digestion bioreactor, a gasification unit (50 kg/h) for syngas production, biogas and syngas storage tanks, biogas-to-biomethane and syngas-to-biomethane conversion units, an electrolyser for renewable hydrogen production, a biomethane storage and utilization system and an internal combustion unit capable of burning biogas, syngas and biomethane. A 25 kWe solar photovoltaic park with battery storage will further support the facility's renewable energy supply.

Within this integrated system, two complementary upgrading pathways will be applied. The syngas generated through waste gasification will be biologically upgraded to biomethane using an advanced biotrickling filter supported by green hydrogen produced via solar-powered electrolysis. This system will employ synthetic microbial co-cultures, an emerging strategy enabling controlled interspecies interactions without the complexity of mixed microbial communities. This approach reduces undesired side reactions and enhances the selectivity and efficiency of biomethane production (Diender et al., 2021). On the other hand, biogas upgrading will be achieved through a photosynthetic scrubbing process integrating a biogas absorption column with a photobioreactor (Rodero et al., 2018).

The LIFE-W2B facility will operate as a demonstration, research and training platform, enabling the testing and optimization of innovative waste-to-energy pathways and facilitating the replication of circular bioeconomy solutions and innovative waste-to-energy systems in other regions.

REFERENCE

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ACKNOWLEDGMENTS

This research was co-funded by the EU LIFE+ project with name "Sustainable Transformation of Waste to Biomethane, through Innovative Upgraded Anaerobic Digestion and Gasification", project number 101213273 and project acronym "LIFE24-CCM-EL-LIFE-W2B".