LIFE Zero Waste Water: exploring the joint management of bio-waste and wastewater

M. Roldán[1], J. Bautista-Giménez [1], J.R. Vázquez[2], A. Seco[1], J. Ribes[1]

[1]Departament d'Enginyeria Química, Escola Tècnica Superior d'Enginyeria, Universitat de València, Spain
[2]Aqualia, Innovation and Technology Department, Spain
Keywords: bio-waste, sewer system, FWD, joint management.
Presenting author email: josep.ribes@uv.es

The consolidated Waste Framework Directive (2018/851/CE) stablished both the requirement of separate collection for the bio-waste fraction from the municipal solid waste by 31st December 2023, as well as targets to preparation for re-use and recycling of 55 % by 2025, 60 % by 2030, and 65 % by 2035 adopting the necessary measures to achieve them. In Spain, where separate collection is required since July 2022 for municipalities with population over 5,000 inhabitants, the presence of impurities is limited to 20 % in 2022 and 15 % in 2027 of the collected fraction. In most of the country, the separate collection of biowaste is being implemented by employing systems that comprise, mainly, specific bins located in collection points, in spite of its proven limitations to achieve good citizen's participation in short time or to meet the quality targets. The door-to-door collection system has also been occasionally implemented with significantly better results for both citizen's engagement and quality of the collected waste, even meeting the legal requirements. However, this system requires an enormous effort from operators and municipalities for its success and some studies point to high environmental impacts related to the transportation (Rossi et al., 2022).

According to Favoino and Giavini (2020), food waste accounts for up to 77 % of the 187 kg of bio-waste yearly produced per inhabitant in Spain, and represents more than 30 % of the municipal waste production. Despite its relevance, the separate collection rate was estimated to be around 3 % of the total production in Spain and 16 % in the European Union. Thus, implementing efficient systems to assure its proper management should have the highest priority to meet the aforementioned targets.

In the Life Zero Waste Water (LZWW) project the proposal to improve the collection process with the lowest environmental and social impacts related to the transportation relies on the use of food waste disposers (FWDs). FWDs are placed under the kitchen sink to grind the food leftovers, in order to easily remove them from households through the sewer system by incorporating them to the wastewater stream. In contrast to conventional treatment schemes, this approach requires the resulting stream to be treated by anaerobic based processes, such as membrane bio-reactor (AnMBR)-based water resource recovery facilities (WRRFs) to promote the production of biogas out of organic matter and the obtention of nutrient-rich effluent suitable for irrigation, and a digestate adequate for composting and agricultural use.

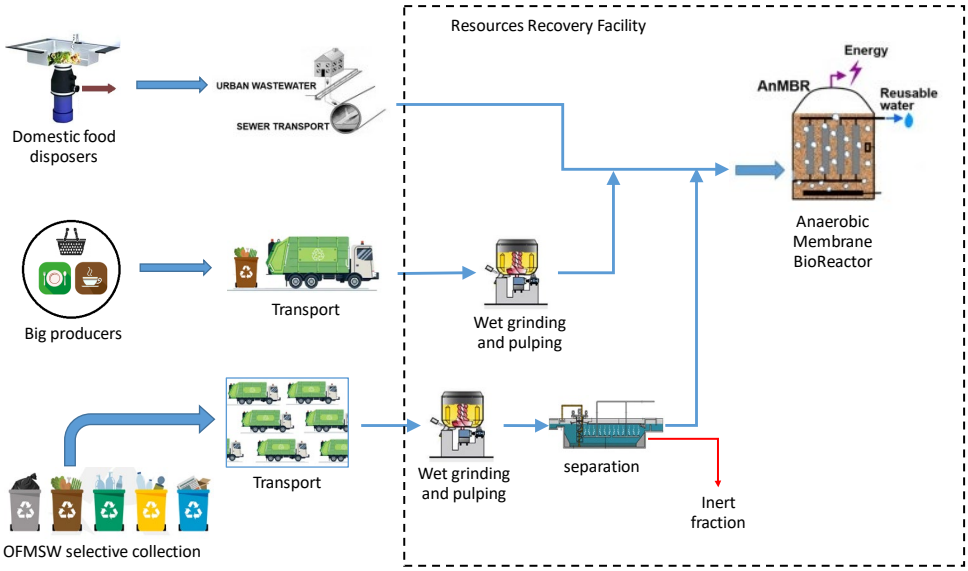
In the LZWW project, the socio-economic and environmental impacts related to the use of FWDs as a collection system will be thoroughly studied and compared to conventional systems. Within the project, both municipal wastewater and food waste will be treated in a demo-scale WRRF (300 P.E.) located in Valdebebas WWTP (Madrid, Spain). The WRRF will treat an average of 50 m^3/d of wastewater and 125 kg/d of food waste that will be provided by different sources: first from HoReCa services and afterwards from brown bins and door-to-door collection systems (see Figure 1a). The WRRF is composed of four modules: 1) AnMBR module, 2) AQUELAN for partial nitritation-Annamox nitrogen removal, 3) a nutrient extraction and recovery unit, and 4) a Smart Water Monitoring and Control System to manage the WRRF according to the nutrient content in the effluent, depending of the end-user demand and regulations (see Figure 1b and Figure 2). The project also studies the adaptability of already existing wastewater treatment plants into WRRFs for municipalities with a plant size below 50,000 P.E., which usually lack of anaerobic digesters, by implementing the AnMBR technology, which allows implementing the Circular Economy and Bio-refinery concepts in the urban sanitation systems.

Acknowledgements
LIFE+, the European Financial Instrument for the Environment, supported and co-financed this study as part of the ZERO WASTE WATER Project (LIFE19 ENV/ES/000631).

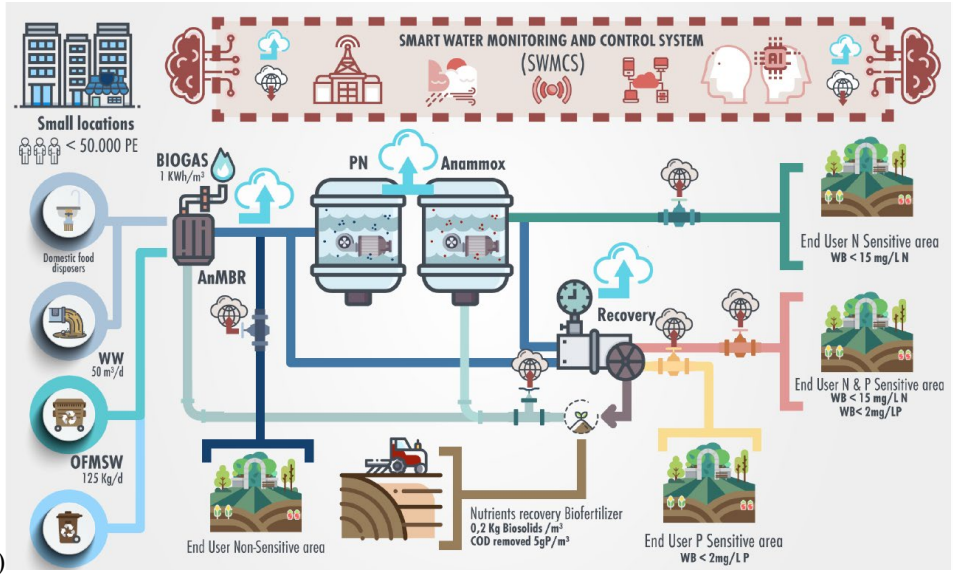
References

Favoino, E., & Giavini, M. (2020). *Bio-waste generation in the EU : Current capture levels and future potential*. 50. https://biconsortium.eu/sites/biconsortium.eu/files/documents/BIC-ZWE report - Bio-waste generation in the EU - current capture and future potential.pdf

Rossi, M., Papetti, A., & Germani, M. (2022). A comparison of different waste collection methods: Environmental impacts and occupational risks. *Journal of Cleaner Production*, *368*(June), 133145. https://doi.org/10.1016/j.jclepro.2022.133145



a)



b)

Figure 1. a) Separate collection system for the biowaste. b) Treatment train for resource recovery.

a)

b)

Figure 2. a) FWDs implemented in the demo plant and b) food waste dosing and AnMBR systems in the Valdebebas WRRF