

Abstract

Urban wastewater treatment plants (WWTPs) are integral to modern cities, safeguarding public health and the environment by treating sewage before discharge. Traditionally, WWTPs operate on linear models, focusing on wastewater purification and waste disposal rather than resource recovery.

However, with the growing emphasis on sustainable development and circular economy principles, there is a paradigm shift toward viewing wastewater and its by-products as valuable resources.

The CIRC-WWTP project aims to increase the circularity of urban WWTPs through two main strategies:

- (1) valorising sewage sludge to produce bioenergy, biofertilizers, medium-chain fatty acids (MCFAs), and biochar; and
- (2) facilitating the non-potable reuse of urban wastewater through advanced polishing of treated effluent.

This will be achieved through specific objectives, including:

- (1) demonstrating the use of electron beam technology for cost-effective sludge treatment, effluent disinfection, removal of emerging contaminants, and direct production of biofertilizer from sewage sludge;
- (2) achieving enhanced biogas production from sewage sludge using electron beam pretreatment;
- (3) enhancing MCFAs production and nutrient recovery from sewage sludge using electron beam pretreatment combined with electro-dialysis technology;
- (4) producing biochar from residual solid sludge for use in soil amendments and effluent polishing;
- (5) developing integrated electron beam and biochar filter technology for advanced polishing of WWTP effluent for non-potable reuse; and
- (6) assessing the applicability of recovered materials for various uses through regulatory analysis, LCA assessment, and techno-economic analysis.

By integrating innovative technologies from each partner—such as electron beam technology, MCFAs production, bio-electrodialysis technology, biochar production, and advanced effluent polishing—this project addresses shared challenges in the partners' countries (Ireland, Poland, and Sweden).

These challenges include improving biogas yields, enhancing platform chemical production from waste sludge, producing biochar for soil enhancement, and enabling wastewater reuse. The collaborative approach facilitates the exchange of expertise, resources, and best practices, fostering innovation and accelerating the adoption of circular economy principles in urban wastewater treatment plants. This synergy not only advances each country's environmental goals but also contributes to the European Union's broader objectives of sustainable resource management and environmental protection.



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► Funding organisations

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