**Abstract for the general public**

Sustainable development is modern concept of meeting human needs without undermining the integrity and stability of the natural system. It covers from ending poverty and other deprivations with effective strategies, that enhance health and education, reduce inequality, and speed up economic growth, to lessening climate change and preserving our oceans and forests. Specifically, a circular economy is currently proposed as a systematic approach for protecting the environment while promoting sustainability, bioeconomy, and economic growth. One of the most promising strategies that are inextricably linked to the circular economy and sustainable development is the recovery and recycling of valuable materials, products, and energy from biological wastes without any negative impact to the environment. However, post-processing wastewater, a byproduct, is a marked limitation for developing hydrothermal technology on a big scale. It is rich in volatile fatty acids (VFAs) and nutrients, such as phosphorous (P), nitrogen (N), and potassium (K), and consequently, a further treatment process is required for improving the qualities before discharge to the environment. The application of sewage sludge as a potential material as a source of lipid and energy production may close the loop of the organic waste stream, to introduce a circular economy sustainably. One of the ways to perform this work is Hydrothermal carbonization (HTL/C) due to its suitable operating and liquid product (HTWW) rich in compounds material (VFAs), which may possibly be re-produce to lipids using biological treatment to allow not only sewage sludge waste management but also bioenergy and nutrients recovery at the same time.

The goal of the project is to develop a cost-effective and energy-self efficient system for VFAs recovery and recycling from sewage sludge in line with the EU policy for renewables and sustainability. And also, this project is plan to determine the best conditions of the hydrothermal process where the optimum production of VFAs in the liquid phase may be achieved and to determine the best conditions of the biological process with application of Yarrowia yeast where the highest production of lipids may be achieved. Furthermore, this project plan to evaluate, if the highest production of VFAs in the liquid phase will be achieved during hydrothermal liquefaction (HTL) than during hydrothermal carbonization (HTC) of sewage sludge due to impact of increase temperature and pressure influencing the organic matter decomposition and also to find out if the liquid phases from HTL are better material for the Yarrowia yeast than from HTC due to higher content of bioavailable VFAs and lower content potentially toxic organic compounds.

The project will start from HTL/C process, using 4 temperature points that ranges from 180 to 300 °C with pressure ranges from 0 to 100 bar. Based on our preliminary (HTL/C) experiment relating to this Preludium proposal was performed in a small scale. Result of the initial experiment and post-processing and from previous (HTL/C) experiences, the HTWW and hydrochar showed that both the operating condition(s) and material type(s) affects the quality and yield of the products. The biological treatment will be performed to qualitatively analyze the products and evaluate their purification progress by column chromatography; analyze the composition of free fatty acid fractions; and analyze the quantity and quality of lipid fractions.

The project expects to allow quantification of the lipids derived from sewage sludge as phosphatidylcholine, phosphatidylethanolamine, phosphatidylserine, phosphatidylinositol, sphingomyelin and their lyso forms. Additionally, the results of the project will contribute to the development of using hydrothermal conversion processes of biological waste to other value-added materials to be a closed-loop system with zero-waste production and corresponding to the circular economy.